Asphalt Pavements.

In order to properly understand the nature and value of the improvements in asphalt pavements, hereinafter described, it is desirable first to obtain some knowledge of the history, nature and present condition of the art in Europe, and especially in the great capitals, London and Paris.

In a pamphlet published in 1721, a Greek professor, Eirini d'Eyrinys, mentions the discovery he had made ten years before, in the Val de Travers, Canton Neufchatel, Switzerland, of a mine of asphalt similar to the beds of that substance existing in the Valley of Siddim, near Babylon. He enumerates its advantages, both in medicine and in building, claiming that it entered into the construction of the walls of Babylon and the Tower of Babel. His successors contented themselves with extracting asphalt or bitumen for medicinal purposes until the end of the century. In 1834, M. de Puvis, in the "Annales des Mines," gave particulars of the manufacture of asphalt mastic at Pyrimont and recorded the confidence already felt in that mastic used for foot paths at Lyons.

It was seen that in summer the pieces of rock that fell from the carts between the mine and the mastic works at Seyssel, compressed under the wheels. In 1849, a Swiss engineer, M. Merian, put this lesson to profit by constructing a Macadam road of asphalt, which was compacted with a roller. This road was spoken of by M. Malo, in 1866, as being still in good order.

The first *compressed asphalte* was laid in Paris, on the Rue Bergere, by M. Vaudry, in 1854, on trial. Another trial was made on a larger scale in 1858, on the Rue St. Honoré, in front of the Palais Royal, where there was a daily traffic of 13,000 one-horse vehicles. The result was satisfactory, and the laying of compressed asphalt for street pavements and of mastic for sidewalks was begun on a large scale, and has been systematically continued until the present time. In 1880 there were 500,000 square yards, or 19 lineal miles of compressed asphalt pavements, and over 4,000,000 square yards of asphalt mastic sidewalks in that city.

The first pavement in asphalt in the city of London was made of compressed Val de Travers asphalt in Threadneedle street, near Finch Lane, in May, 1869, and the next in Cheapside, in October, 1870. At the end of 1878, there had been laid about 11,000 lineal yards, or about 100,000 square yards of this pavement in that city. There are also many hundred thousand square yards of sidewalks laid in asphalt mastic in London.

Malo early restricted the use of the word "asphalt" to bituminous limestone, and in this use he has been followed by most European authorities and experts. Dictionary and encyclopædia makers, as well as chemists, however, use the words asphalt and bitumen interchangeably. In the United States, the term asphalt has been often, but improperly, applied to pavements in which the cementing material was coal-tar or its products. The use of the term *asphalt*, in connection with the American or Trinidad pavement as laid in Washington, is justified both by the analogy that the pavement bears to compressed natural rock and by the fact of that use having now extended over a term of more than ten years.

The principal natural rock asphalts are those of Val de Travers, Seyssel, Sicily, Lobsann and Limmer. The chemical constitution of these is nearly the same, varying somewhat in proportions, and consisting almost entirely of carbonate of lime and bitumen (or asphalt), the latter comprising from 8 to 12 per cent. of the whole. Rock asphalts used for pavements are laid either *comprimé* or *coulé*—i. e., as a compressed powder or as mastic, the former method being considered by Col. Haywood, City Engineer of London, and other standard authorities, as most suitable for carriage-ways, and the latter method for sidewalks and similar uses. For the former use, the rock is broken by a Blake Crusher and powdered by a Carr's Disintegrator, after which the powdered rock is heated in revolving cylinders to from 212° to 284° Fah., and transported to the place where it is to be laid, usually in covered sheet-iron wagons or carts. It is spread over the foundation, which is usually of concrete 6 inches thick, to a uniform depth, by means of rakes, and compressed by heated rammers and other tools, to a thickness of from 1½ to 2½ inches, depending on the probable amount of traffic. A gang of twelve men can lay about 500 square yards per day. Owing to the high cost of this material, caused by transportation across the ocean and to 25 per cent. ad valorem duty, the price of rock asphalt pavement, including a 6 inch concrete base, in the United States, has varied from $4 to $6 per square yard, and consequently very little of that kind of work has been done in this country, although repeated samples have been laid and every means resorted to by the wealthiest of English and French companies for its introduction. Besides the high cost, its slipperiness has also been a decided obstacle to its general introduction into the United States.

When used as mastic, the rock is powdered and melted, Trinidad or other bitumen being used as a flux. The whole is run into blocks for transportation to place of laying. Here it is remelted, more bitumen being added, and the mass mixed with from 30 to 60 per cent. of pebbles, broken stone, grit, etc. In this form it is laid on a base of concrete for sidewalks, brewery floors, and other similar uses. For these uses the mastic can be laid much thinner than for carriage-ways. For many years it has been a dictum of Malo and other European experts that no artificial mixture could be made equal to the natural rock for paving purposes. But this, like many other similar assertions, was destined to be proven untrue. Men said that Columbus could not make an egg stand on end, and that Stephenson could not run an engine on wheels by the use of steam, and that Cyrus Field could not lay the Atlantic cable. All of these things were done, however, and the commerce of the whole world revolutionized in consequence.

Edward J. DeSmedt, a student of the chemical school of the University of Brussels, was early interested in the asphalt pavements of Paris, and analyzed the material used in their construction. Having come to the United States in the year 1861, he began experimenting to find a means of using the culm or fine coal-dust which collects in large quantities where coal is broken or handled. In the year 1869-'70 his attention was called to the subject of concrete pavements, a craze for which was just beginning in the United States. His efforts were directed toward finding a composition that should be equal, if not superior, to the natural rocks of the Val de Travers and Seyssel for paving purposes, and that should rival those materials, at least in cheapness. In the course of his experiments he conceived of the combination of silicious sand or powdered carbonate of lime cemented together by Trinidad asphalt or bitumen, the latter being first tempered with heavy petroleum oils or the residuum of the distillation of those oils. In February, 1870, he applied for United States Letters Patent, which were granted and issued May 31, 1870, numbered 103 581 and 103,582. These were reissued July 27, 1880, numbered 9,324 and 9,325.

Samples of the new pavement were laid in the course of his experiments in and around the works in Jersey City, and in the summer of 1870 about 500 square yards were laid in front of the City Hall, in Newark. For this work the crudest implements were used, and much of the material was burnt and otherwise injured in the process of mixing and laying. A portion of the pavement remained for some time and gave encouragement to perfect machinery and appliances for properly handling the materials.

The American Asphalt Pavement Company, the Grahamite Asphalt Company, the Grahamite Asphalt Pavement Company, and the Grahamite and Trinidad Asphalt Pavement Company were successively formed during the next five years, for the purpose of introducing and laying this pavement, which was, therefore, known at different times as the American, the Grahamite, and the Trinidad asphalt pavement.

Under these various companies but little more than good-sized samples were laid for several years with somewhat varying success, though no positive failure was made. The most notable successes were the pavements laid in 1873, on Fifth avenue, between Twenty-fourth and Twenty-fifth streets, near Worth Monument, and in Trimble place, from Duane to Thomas streets, in the City of New York, and on the east side of Sixth street, in front of Independence Hall, opposite the *Ledger* Building, in the City of Philadelphia. It was these specimens that first fully demonstrated the durabilty of the pavement under the severest tests of heavy traffic and changing temperature that those cities afford.

It was reserved, however, for the City of Washington and Capital of the country to first introduce and adopt the pavement on an extended scale,—this introduction and adoption being rendered the more remarkable from a consideration of the following facts:

Between the years 1871 and 1874, under the inspiration of "Boss" Shepherd, and by his bold and unflinching action the Capital of the Republic was converted from an over-grown village of mud and dust into a beautiful and clean city, the most beautiful in fact, and grandest in possibilities on the Western Continent.

During this time every known form of pavement patented, stone, wood, or concrete, was tried. It was a cold day when any patentee got left if he could induce his member of Congress to give him a letter to the Boss. Then came a long and severe Congressional investigation, which, justly or unjustly, resulted in the overthrow of the Board of Public Works, and the appointment of temporary Commissioners. Under the skillful management of such men as ex-Governor Dennison, Captain S. L. Phelps, and Hon. J. H. Ketcham, order was brought out of chaos, and so prudently did they manage the affairs of the District and City, that in 1878 a Democratic House of Representatives and a Republican Senate adopted the act of July 11, creating the present (known as the) permanent form of government, by which the essential feature of the temporary form, viz: three Commissioners was continued.

Pennsylvania avenue—the finest in the world—had been the first to be paved with wood, the completion of which, in 1872, was the occasion for a big jollification known to history as the Carnival. But the wood soon began to rot. Within four years the avenue was about impassable, and business was rapidly leaving for more desirable localities.

Late in the long session of 1876 Congress appointed a Special Commission, consisting of General H. G. Wright late Chief of the Engineer Corps of the United States Army; [General Q. A. Gillmore, also of the Engineer Corps, now in charge of the Engineer Department of the Atlantic, and Hon. Edward Clark, Architect of the Capitol, with full power to repair that avenue, and with no restriction as to cost, or instruction of any kind, except to select and lay the "best known pavement."

This Commission advertised for public proposals—every bidder to furnish his own specifications. Several score of offers were received, with specifications for pavements of every conceivable kind. The Commission took a sponge and wiped out all pavements composed of wood, all containing coal-tar, and selected the "Grahamite and Trinidad" over all others. Finding that the season was too far advanced for that pavement to be laid and completed on the whole of the surface before winter, the Commission awarded two-third, 54,000 yards, between Sixth street and the Treasury Department to the "Grahamite and Trinidad" pavement, to be laid like the Fifth avenue pavement, before referred to, and under the superintendence of Prof. De Smedt, and the remaining third, or 27,000 square yards, between the Capitol and Sixth street to the North American Neufchatel Asphalt Company to be laid with Val de Travers compressed rock, on condition that it should cost no more than the Grahamite, viz.: $3.78 per square yard. This was the first great victory for the "American," "Grahamite," or "Trinidad" pavement.

The law of July 11, 1878, provided that one of the three Commissioners of the District, to be appointed by the President, by and with the advice of the Senate, should be an officer not lower than the rank of major, from the Engineer Corps of the United States Army, and the two others were to be citizens of the District for not less than three years.

Major Wm. J. Twining was specially selected as Engineer Commissioner on account of his superior engineering qualifications. To him is largely due the credit of discovering the merits of the Trinidad pavement, and especially for its extensive use in the city of Washington.

Thereupon the whole subject of repaving the city came under consideration for immediate action by a new board of commissioners. And again public proposals were invited, each bidder to furnish his own specifications. Meanwhile Prof. DeSmedt was appointed Inspector of Pavements for the District of Columbia. The commissioners then confirmed the judgment of the special commission that paved Pennsylvania avenue by selecting the same pavement which has since been made, and now is the standard pavement in the City of Washington for all streets of suitable grade and character. It is this pavement which has caused Washington to become, *The best paved and cleanest city in the world.*

From the last report of Capt. F. V. Greene, Corps of Engineers, U. S. A., assistant to the Engineer Commissioner of the District of Columbia, made to his superior officer, Maj. Garrett J. Lydecker, U. S. C. E., Engineer Commissioner of the District of Columbia, it appears that since 1878 there have been laid about 700,000 square yards of this pavement in the City of Washington, of which about 550,000 square yards were for replacement of wooden pavements, and about 150,000 square yards for re-surfacing the coal tar pavements.

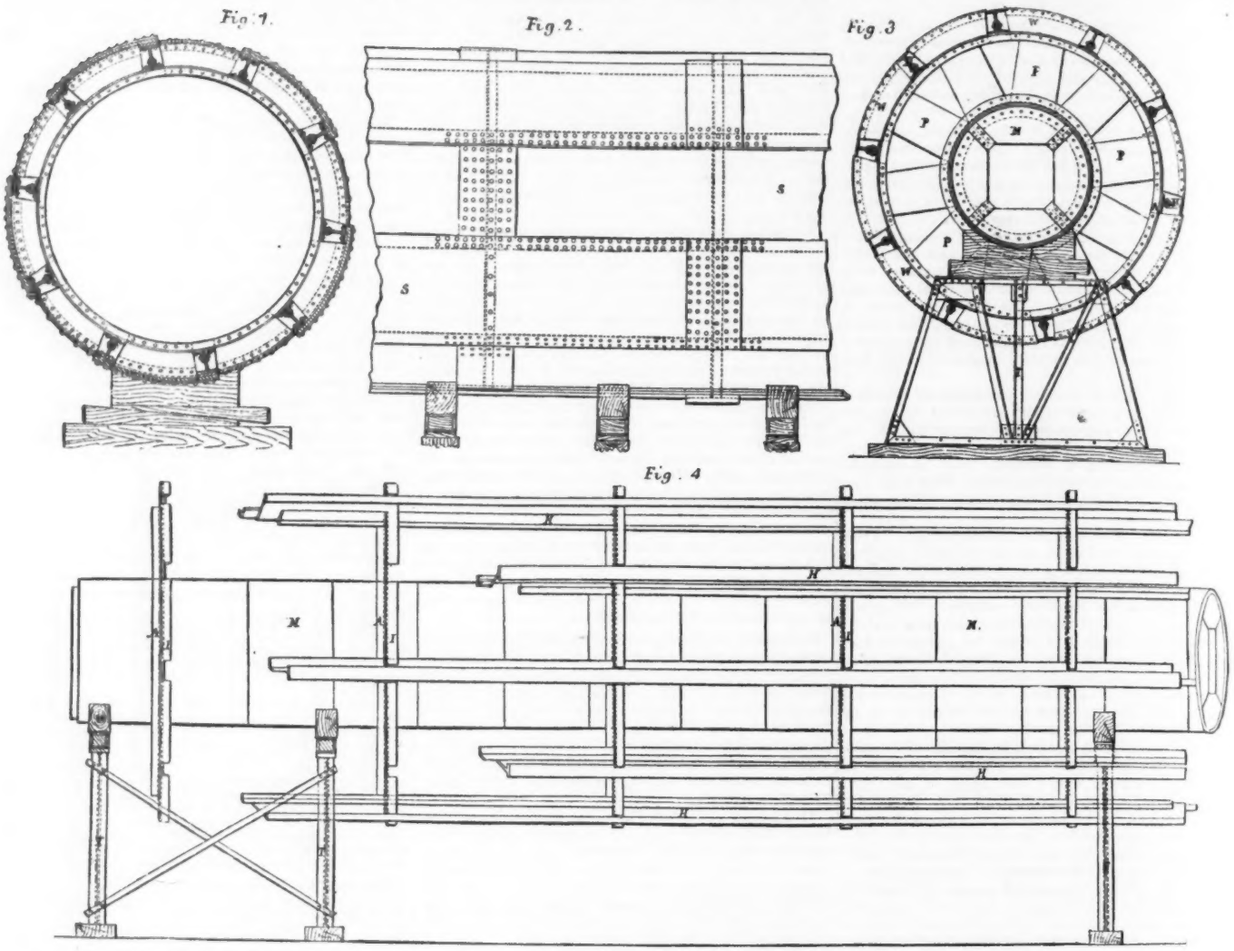
From this report it also appears that the annual cost of maintaining the smooth surface pavements in that city, including the re-surfacing of coal tar pavements, has been 3¼ cts. per square yard. Upon the asphalt pavements proper the cost of annual maintenance has been only about ¾ of a cent per square yard.

The Barber Asphalt Paving Company has laid about ⅔ of the work in the City of Washington, and during the past four years has successfully introduced the pavement into the cities of Boston, Philadelphia, Buffalo, Erie, Youngstown, Omaha, Louisville, St. Louis and Chicago, and are now engaged in laying several miles of the pavement on the famous St. Charles Avenue, in the City of New Orleans. Over 1,500,000 square yards or about 100 lineal miles have been laid by this company during the past six years. They claim that the pavement can be laid successfully to suit any climate and any traffic.

The materials which enter into its construction are exceedingly durable, and are not subject to atmospheric changes. The cementing material in the wearing surface is of the best of Trinidad asphaltum, which is a natural bitumen that has been subject to tropical heat for centuries. When properly prepared for use, it is very ductile and tough. It contains no volatile oils which are found in such abundance in coal tar and its products, and its melting point is many degrees higher than that of tar. For these reasons, it constitutes the best cementing material yet discovered for paving purposes.

Aside from all questions of hygiene or health and of comfort, there are two considerations of a pecuniary character which are too little thought of by engineers, who are too much inclined to limit the scope of inquiry in selecting material for paving purposes to the two questions of cost and durability. The first of these is the saving in wear and tear of vehicles; this saving on a smooth surface pavement must amount to 50 per cent. of the cost on block pavement of whatever material. The other point relates to power of traction. In a communication to the Engineers' Club of Philadelphia, made by Rudolph Hering some months ago, it is laid down that if one horse can just pull a given load on two iron rails, it will take one and two-thirds horses to pull the same load upon an asphalt pavement, three and one-third upon good Belgian blocks, five upon ordinary Belgian blocks, seven upon good cobble stone, thirteen upon ordinary cobble stone, twenty upon an earth road and forty upon sand. From this proposition the conclusion is irresistible that the substitution of asphalt pavements for the various stone pavements now in common use in our cities, would result in saving from 50 to 75 per cent. of the cost of transportation of passengers and goods. And this is a matter which affects every individual residing in our cities. It means the cost of all building material, food and clothing, as well as the cost of all materials required for manufacturing purposes and also of the manufactured articles, could be materially reduced by this saving in the cost of transportation. These are questions which our engineers, who are specially interested in city pavements, should investigate very carefully. It affords a rich field for experiment.

THE FORTH BRIDGE; DETAILS OF TUBES.



THE FORTH BRIDGE,

On Manipulating the Material, and Building and Drilling the Great Tubes of the Forth Bridge.*

BY ANDREW S. BIGGART.

(I)

The Forth Bridge has on various occasions formed a theme of deservedly widespread interest, and the general character of the undertaking is more or less familiar to engineers. A comprehensive view of the subject and of the numerous engineering questions involved, has also been lately so ably given by Mr. Baker, that the writer purposes in this paper to at once pass on to examine some of the later details of the manufacture of the superstructure, such as that of the work in connection with the great tubes.

One of the well known features in the design of this undertaking demands that struts of hitherto unequalled length and capabilities for resisting thrust, be employed. The form which best fullfils these conditions is the tubular. As well-nigh six miles of tubes are required in the completed bridge, it at once becomes evident that the construction of of these could only be effected within a reasonable time, by the adoption of special plant. Owing also to their novelty of form and great size, no machinery was in existence capable of dealing with such work. On account of this, and for various other reasons, Mr. Arrol determined to design special plant for the whole work, the description of a part of which, and the mode of working it, can be but scantily treated of in this paper.

The struts required are of various dimensions, ranging from that of the largest, which is 12 feet diameter, to that of the smallest, which is only 3 feet. The description of the former only will be considered in this paper, since all are very much alike in design.

Fig. 1, on the present page, shows the cross section of one of the 12 feet horizontal tubes between the piers. It consists of 10 plates and 10 longitudinal H beams, stiffened at intervals of 8 feet by means of the circular girders shown in elevation. The girders, again are made up of diaphragm plates, connected to inner and outer angles, the former being rivetted to the H beams, while the latter are similarly fixed to the tube-plates.

The work to be performed is somewhat as follows:

The first, and for a time the most difficult operation (owing to causes to be hereafter referred to) was the curving of the heavy plates. These, it may be mentioned, are 16 feet × 4 feet 4 inches × 1¼ inch and 1½ inch thick, and weigh from about 28 cwt. to 32 cwt. each. The method now adopted is to bend them while hot in a large hydraulic press, from which they are removed, and allowed to cool slowly. When cold they are again placed in the press, and straightened finally. The edges and ends are then planed, and each plate is weighed, marked, and laid aside, ready to be placed on the tube when required.

The longitudinal H beams are made up of a deep webbed tee and two angles, being partly drilled through these before erection. The circular girders are also partly drilled before being placed on the mandrel. These different parts from the main tube proper, leaving out the connections to skewbacks, the girder fixtures, tees, and other minor details, with which it is not at present intended to deal.

The tubes are built round about a mandrel, being supported therefrom by temporary connections, and are drilled through the various parts, while in exact form they are intended to be when finally erected. (See Figs. 3 and 4).

This hasty sketch of the different steps of the work required to be executed, will enable the details to be more clearly followed:

The plates are heated in gas furnaces, of the style shown in Figs. 7 and 8. The producer is close at hand, and from it the gas led along the tube T to the box B, and thence distributed to the different furnaces by means of other tubes.

The gas is admitted at the side, as well as the back of each furnace. This, by the way, was an afterthought, to enable the plate to be more evenly heated than when the gas was admitted at the back only, and it turned out a decided improvement.

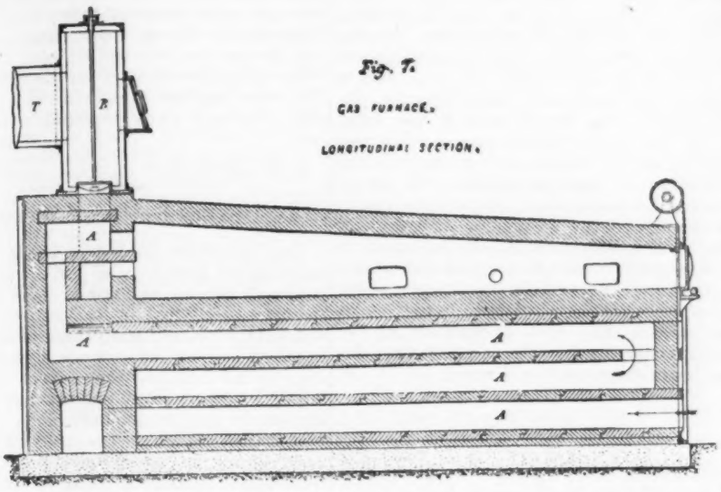
The escaping gases pass off through the flues G, which are highly heated thereby, and these in turn give a part of their heat to the incoming air, which is then passing along the flues A, on its way to the open furnace.

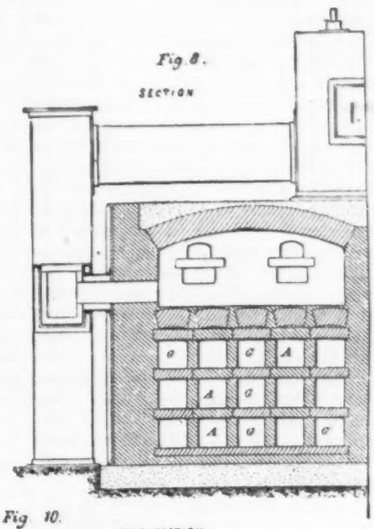
The plates to be curved and heated to a dull red, after which they are withdrawn from the furnace by means of a hydraulic ram. To the end of the chain from the ram is attached a pair of tongs, made so that the greater the pull required, the firmer is the grip. The plate is withdrawn from the furnace on rollers, and run over a table into the hydraulic bending press shown by Figs. 9 and 10. A pressure of 800 tons is now applied while the plate is between a set of convex and concave blocks of the form necessary to bring it to the proper curvature.

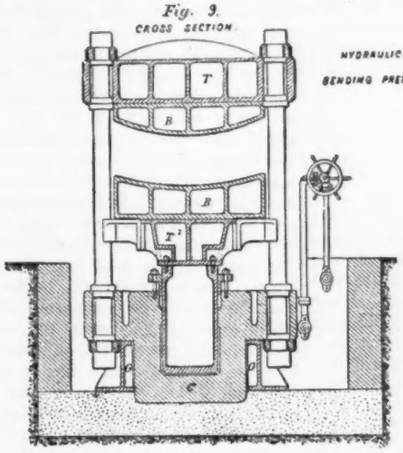
Almost immediately on the blocks being separated, the plate is seen to be undergoing a change of form, and this so quickly that it is

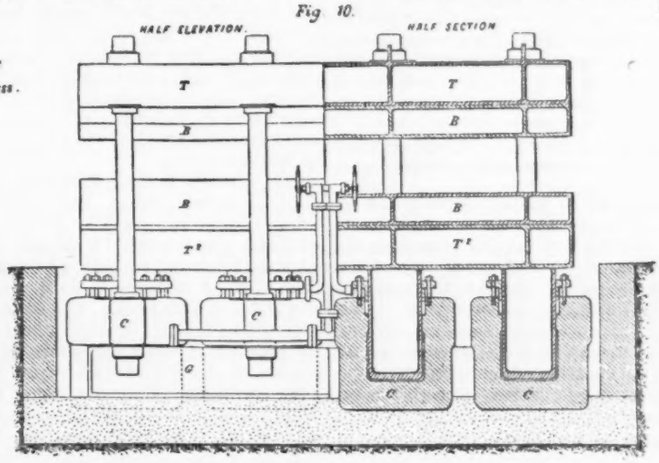
*Paper read before the Institution of Engineers and Ship-builders in Scotland.

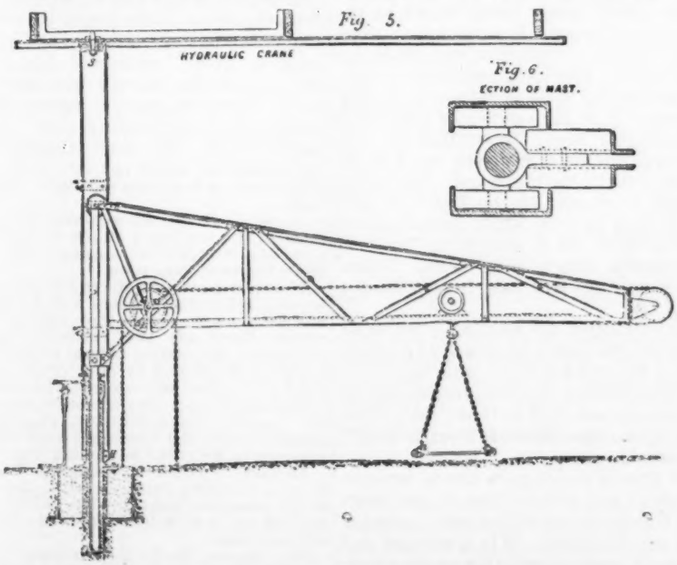
THE FORTH BRIDGE; HEATING FURNACE AND BENDING PRESS FOR PLATES.

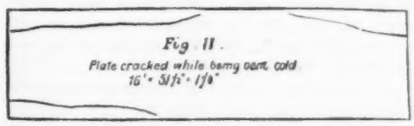












quite perceptible to the eye. Sometimes the convexity becomes greater, while at other times it is the reverse. In all cases the plate warps longitudinally, this taken place principally at the ends. The distortions are most irregular and inexplicable, a plate seemingly under exactly the same conditions assuming a totally different form, nay perhaps the very reverse of that taken by the immediately preceding one. On being removed and allowed to cool, the plates gradually become in almost every case somewhat better, but scarcely ever sufficiently so as to be suitable for the purpose for which they are intended.

Many methods were suggested, and tried, to overcome this warping of the plates: thus, for instance, the edges were covered up, thereby allowing to cool more from the centre; another mode was to reheat and give them a second squeeze; yet another was to allow them to cool partly, lying on a series of iron rollers, set to the true form the plate should take. These and others gave only very varying success. The plan finally adopted was to curve a quantity at a time, laying each plate, as it left the press, on the top of the immediately preceding one, with a layer of ashes between, allowing them to cool in piles of convenient size. When cold, each plate is again placed in the press, and straightened by means of repeated squeezes, strips of thin iron being placed above and under the points necessary to be brought to the true form. This answers the purpose admirably, and is the only method now in vogue.

A somewhat striking incident happened during these preliminary trials. It arose out of an attempt to bend one of the 1¼ inch thick plates while cold. During this process the plate cracked in several places, although the curve was only equal to that of a circle with a 6 feet radius. Samples for bending and tensile tests were cut off, and quite up to a specified quality. (See Fig. 11).

Mr. A. Arrol attributed the failure to unequal cooling at the steel works, and this is borne out by the fact that different parts of the same plate are not uniformly easy or difficult to cut, but both these experiences are often found in a single plate.

Mr. Baker thought the failure of the plate to stand the bending was due to the fact that its edges and ends were not planed, but were in the state they were in when they left the shears at the works. He had made a series of experiments with sheared and planed plates and from the results obtained arrived at this conclusion.

Annealing removes satisfactorily both these objections, and in this lies the great benefit of

bending the plates while hot, and allowing them to cool as described.

The hydraulic press (see Figs. 9 and 10), for bending the plates, consists of a set of four 24 inch cylinders C, resting on two cast iron girders G, and supporting by means of two 7 inch wrought-iron columns, from each cylinder, a fixed table T overhead. On the top of the ram is placed another table T^2, which is raised and lowered in conjunction with the rams. Between these two tables are placed the blocks B, required to bend the plates to their particular form, equal in this case to a curve the radius of which is 6 feet. The pressure brought to bear on the plates while being stamped is about 800 tons, provision being made for doubling this if necessary. The lower pressure has thus far been found sufficient for all purposes.

After bending one of the first plates, it was kept between the upper and lower blocks for a few minutes while it was yet hot. The consequence was that the side of the block next the plate heated much more rapidly than the other, or remote side.

This induced a very heavy strain on the metal, so much so that it broke the upper one completely through, at the same time giving a report somewhat resembling that of a discharge of a pistol.

(TO BE CONTINUED.)

Street Improvements.—How They are Paid for in Chicago and other Cities.

Superintendent of Streets Mehan has received from Chicago and Cincinnati, answers to his recent letters of inquiry regarding the manner of which the charges for street improvements are made. In the letter from Chicago is the following statement:

"All street improvements, such as curbing, grading and paving, also the construction of sidewalks, are constructed and paid for from special assessment levied directly upon abutter's property and adjacent property benefited. The assessment is levied and the amount fixed by three commissioners appointed by the court, in amounts varying according to the kind of improvements and cost of the same. The work is paid for by the city treasurer upon estimates issued by this department when the taxes for the same are collected."

"Street Repairs," said the Commissioner from Cincinnati, "are paid from the general fund. Sidewalks and resetting of curbs are done by property owners upon personal notice. The first cost of streets is paid by property owners (except intersections and 2 per cent. of the whole cost, which is paid from a fund called "city portion street improvements) upon receipt of petition signed by three-fourths of the property frontage.

"In the city of Philadelphia streets are paved by the city upon a petition of a majority (in number) of the property owners in any complete square. Work is advertised and let to the lowest bidder; the contractor receives in payment assessment bills against abutting property, made out at the full rate of his bid, which includes maintenance for a period of three to five years. The city pays for street intersections and assessments against churches, charitable institutions and other unassessable property. It is the duty of the abutting property owner to grade, curb and have sidewalks, and he must do so when notified by the highway department, under ordinance of councils. If he fails to do the same, a lien is filed for the full amount. The property-owner is furthermore obliged to maintain the curbs and side-walk pavements perpetually, but is not obliged to maintain the cartway pavement; the city assumes the responsibility and the cost of maintaining the cartway pavement after the street has been paved three years. "For sewers and water-pipes the property on each side of the street is assessed $1.50 per front foot for sewers and $1 per foot for water-pipes, with deductions where the property has two fronts."

From Baltimore a reply was received which states: "The city pays all bills for grading, paving and curbing of new streets; but the whole cost is assessed on the property-holders abutting on the improvement, in proportion to the number of front feet owned by each, the city paying the whole cost of the cross streets or intersections. The paving and repaving of side-walks is done by the property holders at their expense wholly. "In repaving streets, the ordinances require the city to pay one-third of the whole cost and the property holders two-thirds, the city paying, as in the case of new streets, the whole cost of the intersections. This makes the city pay about half of the repaving assessment of cost, as in new streets. The cost of maintaining the streets is borne by the city, and has been for some years about $75,000 per annum.

Wood Preservation.

CHARLESTON, S. C., February 9.—I will give the readers of the *Lumberman* as well as I can, a description of the carbonizing and creosoting process with an account of the process of making the oil for preserving piles, timber and lumber. The preservation of wood is an interesting subject, especially where the teredo or salt worm is troublesome to piling, and the life of wood an object.

The process I recommend for preserving piles is simple, cheap and effective. The whole cost of the plant of ordinary capacity will cost about $2,000. A furnace is built of common brick and so built as to give a uniform heat. A cylinder is built over the arch and inclosed with brick. The cylinder is, say 20 feet long, the pile or stick of heavy timber is run into this cylinder and sealed up and carbonized or charred by dry heat for about one hour. It is then pushed through and while the pores of the wood are open it receives a bath of oil. This oil is made out of the best rich yellow pine, that contains a large per cent. of creosote, that article being known as the best preserver of wood. It is made from wood tar, and yellow pine produces more tar than any tree that grows. The oil is made by distilling; all the acid of the wood is extracted, leaving the oil pure. It is the essence of rich wood forced into poor wood. By treating the pile with dry heat the water is driven out and replaced by oil while the pile is hot. The pile is carbonized or charred to the depth of one-fourth of an inch. The teredo cannot subsist on charred wood. It is impossible for it to enter, and work, with nothing to eat. I have seen the teredo two feet long in piles treated with dead oil.

Ordinarily a plant for treating piles costs about $75,000, but such a plant will do no more work than the one I describe, and that costs $2,000. Piles treated by this process can be sold for $15, and are sold at that price; while if treated by the other methods from $25 to $40, each, is asked.

The oil that is in common use is brought from England, and is the refuse of gas works boiled in iron tanks and mixed with naphtha, and then called dead oil. It is a mineral and nothing more, while creosote is a product from wood or wood tar. This oil can be made very cheap, and in vast quantities; is the only oil in use that contains creosote to any extent. At present the United States imports about 10,000,000 gallons of worthless stuff every year, when we can produce a much superior article. I say worthless; it is worse than that. Timber treated with dead oil will not last long: while this pine oil will prolong the life of wood many years. This oil penetrates at once, leaves a gummy substance, thus making the timber impervious to water.

The only way to expel water from timber is by dry heat. It cannot be done by steam.

To treat cross ties: Put 500 in a brick dry house; keep up a slow heat—dry heat; keep them under fire 10 or 15 hours; while hot immerse them in a bath of this pure oil and let them remain for six hours, and I will stake my life that they will last 25 years. The result is the same if made out of soft pine or sap pine. The more sap the greater amount of oil the wood will take—about 20 pounds to each cross tie. M. CONNELL.

N. W. Lumberman.

Georgia Roads and Bridges.

The Committee on Public Roads have inspected the highways of the county in a thorough manner, and report them generally (without specifying) in bad order. In their opinion the roads in many places need rebuilding to such an extent that the work cannot be done by the ordinary road labor. The Committee would therefore suggest that a part of the convict gang be detained under a competent overseer to rebuild the roads where necessary, raising the grade, opening ditches, putting in good trunks and doing all work necessary to secure to the people in the country easy ingress and egress into and from the city. Good roads are a necessity if we desire to see the country improve. Without good highways people cannot be induced to settle on lands distant from the city. We understand that the County Commissioners have had under consideration a system of general county improvements in connection with the drainage system. This plan comprehends the preparation of an accurate map of the county made by actual survey, in which will be shown the public roads and bridges and drainage canals. Such a map will be invaluable, and we trust it will be prepared without delay. With such a map a system of public improvements could be carried on intelligently and effectively. The county has a large gang of convicts, which, we would add, en passant, can be increased almost indefinitely by recruiting from the hundreds of idlers and vagrants that infest the city and our adjacent country With this force under proper supervision the county can be systematically and thoroughly canaled, broad, well-built highways constructed, and the country from the Savannah to the Ogeechee made a garden tilled by a prosperous and healthy, and therefore a happy people. This is no fancy picture, but a practical plan, which can be carried out to its fulfillment in less than a decade. Now for details.

Augusta Road.—In general fair condition. Some of the new work on the bridge has been done in a very inferior manner, and will have to be replaced very soon.

Louisville Road.—In places almost impassable especially between the four and five mile posts, and between the seven and eight mile posts, where there are two corduroy roads, over which it is impossible to haul heavy loads, and between the 12 and 13 mile posts, where the road is very low and covered with water.

Ogeechee Road.—Having been examined by the County Commissioners, and they being about to have the necessary work done on the causeways, we make no further report.

Skidaway Road.—Leading to the Isle of Hope is in pretty fair order with the exception of the causeway near the isle, which is badly washed out, and unless attended to soon will be impassable.

Pine Barren Road.—In fair order.

White Bluff Road.—We recommend a substantial railing be put on bridge at White Bluff Church, and that a bridge be placed at the culvert at the 6-mile stone, the bridge to be wider than the road as it now is, and secured by good railing.

Ogeechee Cross Roads.—In good order.

Montgomery Cross Roads.—In good order.

Middle Ground Road.—Some low places need attention.

We would especially recommend to the County Commissioners, who have now in the convict camp acout 110 convicts, to detail a portion of them, under a competent overseer, to do such work on the roads as is now absolutely necessary.

Presentment of Grand Jury, December Term 1884.

The Railways of the World.

BY PAUL TRASENSTER.

(Cours de Géographie industrielle et commerciale a L'Ecole des mines de Liege.)

The following statement is taken from one prepared by Mr. Paul Trasenster, for the instruction of the students of the Ecole des Mines de Liege. It is said to be the most complete, and also the most correct, statement yet compiled of the railway mileage of the world. The original is given in kilometres, which are here reduced into English statute miles omitting fractions. The distances, for 1882, are complete, and those for 1883 are given as far as was known to the author at the date of publication:

[Countries.	Miles of Railway open.	
	1882.	1883.
EUROPE.		
Germany	21,692	22,260
Great Britain	18,457	18,681
France	17,755	18,256
Russia	15,160	..
Austria-Hungary	12,406	13,045
Italy	5,720	5,810
Spain	4,866	5,236
Sweden and Norway	4,808	..
Belgium	2,636	..
Switzerland	1,775	..
Holland	1,219	..
Roumania	912	..
Turkey	864	..
Denmark	1,082	..
Portugal	938	961
Luxemburg	264	..
Greece	8	53
Total for Europe	110,582	..
ASIA.		
British India	10,126	..
Ceylon	177	..
Java	380	..
Asia Minor	308	..
Japan	138	175
Total for Asia	11,129	..
AFRICA.		
Egypt	941	941
Algeria and Tunis	1,153	1,172
Cape	959	..
Natal	99	155
Mauritius	82	..
Reunion	71	..
Total for Africa	3,305	..
AMERICA		
United States	114,838	121,592
Canada	7,516	..
Mexico	2,235	2,883
Costa Rica	124	..
Nicaragua	35	..
Guatemala	28	..
Honduras	56	..
San Salvador	10	..
Cuba	874	..
Porto Rico	8	..
Jamaica	25	..
Trinidad	43	..
Columbia	107	..
Venezuela	70	92
British Guiana	21	21
Brazil	3,016	..
Argentine Republic	1,626	1,799
Paraguay	45	..
Uruguay	181	..
Chili	1,177	..
Peru	1,148	..
Bolivia	81	..
Ecuador	31	76
Total for America	133,285	..
AUSTRALIA.		
New South Wales	1,312	..
Victoria	1,333	..
South Australia	913	..
Queensland	865	..
West Australia	94	..
Tasmania	166	..
New Zealand	1,462	..
Total for Australasia	6,195	..
Total for World	264,496	..

Abstracts of Papers, Inst. Civil Engineers.

ANCIENTLY, in many parts of France, when a sale of land took place it was the custom to have twelve adult witnesses, accompanied by twelve little boys; and when the price of the land was paid, and its surrender took place, the ears of the boys were pulled and they were severely beaten, so that the pain thus inflicted should make an impression upon their memory, and if required afterward, they might bear witness to the sale. Later, when a criminal was being executed, parents whipped their children, so that they might take warning of the example, and keep in the path of virtue.

The Consumption of Sleepers on French Railways.

BY H. MATHIEU.

(Revue Générale des Chemins de fer, May 1884, p. 229).

The object of the author is to ascertain the situation in France in respect of transverse sleepers of wood, the annual consumption of such sleepers, the means of maintaining the supply, and the different kinds of wood used for sleepers; to ascertain, moreover, whether the exclusive use of wood for sleepers should be continued. Iron sleepers, though used extensively in Belgium and in Russia, are but little used in France, and have only been used experimentally as yet.

From the returns of the six great railway companies in France for the five years 1878 to 1882, it appears that the average annual consumption amounted to 2,749,292 sleepers on 12,720 miles, average length of line open, or 18,660 miles of single way; at the rate of 147 sleepers per mile of single way. Sleepers of oak are the most common, constituting two-thirds of the whole number; beech sleepers constitute one-fifth; next come those of pine and pitch-pine, about one-ninth; and lastly, sleepers of fir, constituting little more than 1 per cent. of the total number. If an allowance of 25 per cent. of the total length of single way be made for lines at stations, the total length of single way laid for all purposes amounts to 23,325 miles, and the consumption of sleepers to 118 per mile of way. The annual rate of consumption varies with the kind of wood used. The Eastern and Orleans railways, on which four-fifths of the sleepers are of oak, show the lowest rate of consumption, whilst the Southern Railways, on which two-thirds of the sleepers are of pine, shows the highest rate of consumption. But, on the contrary, the cost for new sleepers on the Southern Railway is very little more than the average for the other lines. During the five years already noted the average annual cost for new sleepers amounted to about £30 per mile.

In applying the foregoing data to the entire system of railways in France, of which there were, on the 1st. of January, 1883, a total length of 30,980 miles, the estimated total consumption of sleepers amounts to 3,618,400 for the year 1883. For the year 1896, when the railway system will be completed, there will be required, for maintenance only, 4,918,400 sleepers, of which the forests of France may supply 4,000,000, leaving the remainder to be imported from foreign countries.

The author concludes with the observation that, in his opinion, the trials of metallic transverse sleepers that have hitherto been made have not yet led to a satisfactory solution of the problem, and that they should be continued.—*Abstracts of Papers; Inst. Civil Engineers.*

Steel Projectiles.

About a month ago we learned that during practice at Cronstadt on September 26, an 8 inch breech loading howitzer burst explosively severely injuring a large number of the detachment working the gun. This howitzer was constructed at the Goverment factory at Perm, and formed one of a number of similar weapons destined for arming the coast defences. It was made of steel, with steel hoops, and fired a projectile of 200 lb. with 30 lb. of powder.

This disaster shows that liability to accident is not the unique characteristic of British guns as a section of our critics would have us beleive. When a projectile broke up on a recent occasion in the bore of a 100 ton gun at Gibraltar, there was no lack of announcements of the failure of another English gun, and one writer at least of some pretensions to knowledge of artillery matters, without waiting to hear the whole facts, indulged in a jeremiad on the subject of British ordnance in general. It will, we suppose, be of small interest to these gentlemen to learn that the official examination of the gun has declared the injuries to be unimportant and easily repairable on the spot. Wall steel projectiles are generally adopted, an occasional break-up of cast-iron shell in the bore of a gun may be anticipated, but that our guns should support the unusually heavy strain thereby produced with only slight injuries to the groves where the broken pieces of the projectile struck, must be considered as a satisfactory demonstration of their general excellence of construction apart from the question of their design.

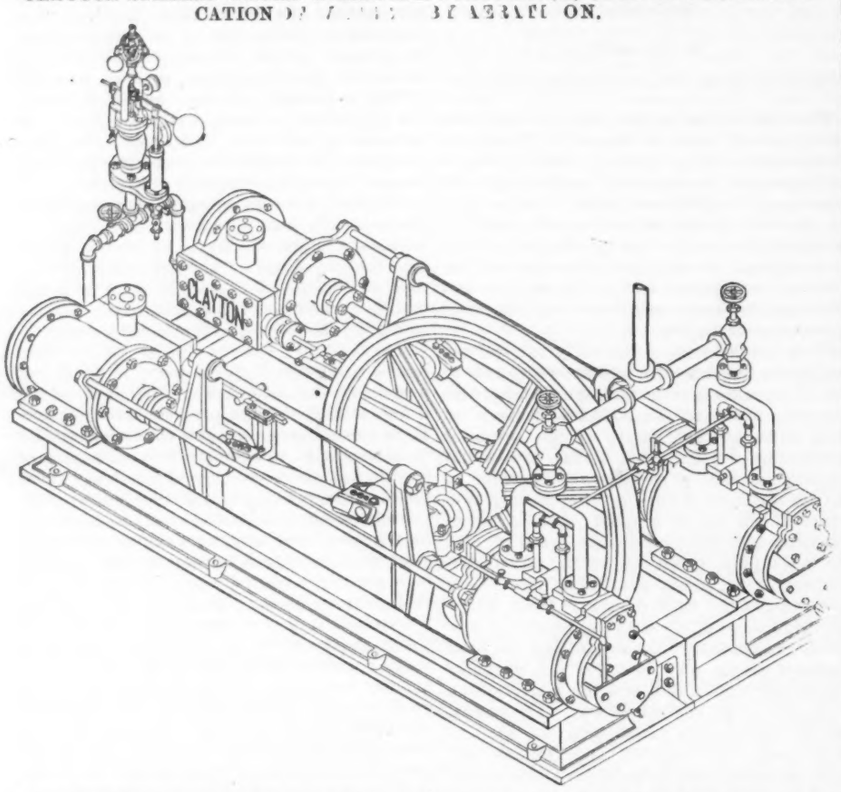
It is certainly curious that as yet so little has been done in England towards providing a projectile for our heavy modern guns which is able to utilise a high proportion of the enormous power developed. It is characteristically inconsistent to re-arm our fleet with guns of greatly increased power, and yet leave them the old description of projectiles made of relatively weak and brittle cast iron, which have proved themselves very much inferior to steel shell, of which several foreign powers have already acquired a supply for use with their armour piercing guns. Of what use can it be to add largely to the energy developed in the projectile, if the material of which it is made remains inherently weak, and consequently incapable of transmitting the stored up work to the plate attacked? The excellent results obtained recently with the 100 ton breechloading gun fired against compound and steel targets at Spezzia were in great measure due to the admirable steel shell used, manufactured by Krupp. What the special process of manufacture of these projectiles may be, is not known, and the secret is jealously guarded, but the results obtained with them have shown extraordinary hardness combined with great tenacity. Much of this may be due to the excellence of the material used, but it is probable that their unusual power of withstanding the vibration induced by impact against steel and steelfaced armour, is due to special tempering, to which it is known Mr. Krupp has devoted great attention. One advantageous feature of these shells is that their heads are solid and not furnished with separate points or tips as is the case with some English projectiles of the same material Whatever advantages may be gained by the use of a specially hard point loosely fixed to the front end of shell in favoring the manufacture and tempering as well as the subsequent penetration of the apex, is unquestionably lost in the diminished capability of the shell as a whole to withstand the enormous vibration and crushing strain of penetration, and the tendency of the point itself to wedge or split open the body of the projectile,

One great objection to the introduction of steel shell is their cost, but that sooner or later they will have to be employed is inevitable, unless we wish to see our cast-iron projectiles shivering harmlessly against the armour of our opponents, whilst their steel shells are playing havoc with ours.

Russia, Germany, Italy, and France are providing themselves with a large supply of these projectiles, and we cannot afford to be left behind. It is also probable that when our manufacturers turn their attention to the subject it will be found possible to considerably reduce the present price of manufacture, as it is known that Mr. Krupp has succeeded in producing steel shell at a comparatively low figure.—*Engineering.*

A FURNACE PLANT SOLD FOR $870,000.—READING, Feb. 20.—The Robesonia Furnace plant, in this county, which was sold to Wm. R. White and Mrs. Henry Borie, both of Philadelphia, was purchased for $870,000, probably the largest amount ever paid in this State for a similar property. This furnace has the exclusive right to take as much ore as it can use forever from the famous Cornwall ore hills. Hence its great value.

CLAYTON SPECIAL WATER WORKS AIR COMPRESSOR, USED IN THE PURIFICATION OF WATER BY AERATION.



The Purification of Water by Aeration.

Probably the latest application of compressed air is in the direction of purifying water by aeration, under the system invented by Prof. A. R. Leeds, and successfully experimented upon in the Philadelphia Water Department and by the Hackensack Water Co. of New Jersey.

The experiments in Philadelphia were conducted under the direction of Col. Wm. Ludlow, the chief engineer of the department, his assistant, Mr. J. G. de Kinder and Prof. Leeds himself; the results of these experiments were satisfactory as shown in a report of the Secretary of the Franklin Institute, Dec. 17, 1884, and given in abstract in ENGINEERING NEWS, Jan, 10, 1885. In both of the cases mentioned the compressed air was furnished by a Clayton Duplex, Double-acting Air-Compressor, an illustration of which is given herewith.

At Hackensack, N. J., the system has been permanently adopted, and Chas. B. Brush, the Chief Engineer and Superintendent of the Company, writes, in substance as follows:—He says that in Sept. 1884, a Clayton Air Compressor was set up for the purpose of aerating the water furnished the City of Hoboken. Since that time air has been forced into the water under a pressure of 118 lbs. to the square inch, and the result has been eminently satisfactory," in securing a more pure and wholesome water for domestic use.

The plant at Hackensack and Hoboken is the first erected for the practical application of the Leeds process, and from the general success reported there, and in the Philadelphia experiments as well, it does seem that the system is capable of wide application. The theory upon which it is based is a sound one, and the compressed air can be introduced into the mains leading to the reservoirs with comparatively little expense. The action of atmospheric air in modifying and in part removing the impurities contained in the average water supply has been long recognized, and the experiments of Professor Leeds prove that the action is greatly increased by intermingling the two fluids under pressure. The inventor of the system claims that the greater the pressure the greater is the absorption of oxygen, and consequently the greater the reduction of the impurities. The precise measure, however, of the decrease has not yet been ascertained.

The illustration given shows the Clayton Air Compressor used in the trials mentioned. This machine has already been fully described in this journal in the issue of September 24, 1881, and the description is therefore not repeated. The "indicator diagrams," taken from the steam and air cylinders, at the date mentioned, show a great degree of economy in the consumption of fuel, and later improvements have still further increased its efficiency. Any further information required, concerning the air compressors, will be furnished on application to the makers, whose address will be found in the advertising columns of this journal.

River and Harbor.

Messrs. Ross & Sanford, the new contractors for dredging the Savannah river and harbor, are building a dredge at the lower end of the Savannah, Florida, and Western Railway Company's wharves, which when completed, will be the most powerful dredge in the South. It is expected it will be in operation on or before March 1. The hull is about finished and is ready for the launch, which would have taken place yesterday had the tide proved suitable. Should it be favorable the craft will be launched early this week. The blocking for the dredge was laid on Dec. 17, and while the work is nearly all done it has been delayed by non-arrival of the machinery, which is not all here yet. A small portion of it, with some of the iron castings, arrived last Wednesday, the manufacturers mistaking the point of shipment for Charleston, where it arrived about ten days ago, and only reached here from Charleston on Wednesday. This mistake costs the contractors, besides delay in the work, $500 additional expense, which is understood, however, will be borne by the shippers of the machinery. The work of constructing the hull is under the supervision of Mr. Edward Fair, a thorough mechanic of long experience, having been in the employ of the contractors for sixteen years, and who has superintended the building of all their dredging machines.

The dimensions of the hull are as follows: 90 feet in length, 34 feet 4 inches breadth, and 9 feet 9 inches over all in depth. It is to be double-bottomed with four-inch plank and sealed with timbers and two-inch "double-fastened, the frame work being built according to the "Howe Truss" style, which gives the hull tremendous power and resistance, necessary for the character of the work she is to be employed in, and the heavy machinery and iron work which will have to be carried. The house work on deck will be about 48 feet long, 23 feet wide and 9 feet high. The machinery will be of the newest and most approved pattern, and is being built by the Lidgerwood Manufacturing Company of Brooklyn, N. Y. The craft is to be fitted with double friction drums 6 feet and 4 feet friction on either end. Double-engines 14 × 18, 6 inch shaft; crank shaft 6 inches in diameter, and gypsy engines for hoisting spuds, which are very complete, being of double action, going backward and forward, also gypsy shafts for turning her around, supplied with two hanging chains and sheaves 2 feet 3 inches in diameter, with brass boxes; she will have two spuds 24 inches square, with wells. There is also an A frame already completed and which is a fine piece of work, with three 2-inch iron connecting rods. This frame goes up forward. She is also supplied with Gannon's patent multiple effect water condenser with copper pipes attached, and wrecking pumps with two 6-inch sea-cocks for supplying and discharging water. Neither the dimensions of her boilers and their power nor the power of her engines could be given by Mr. Fair, as they had not yet arrived. It is their non-arrival that delays the completion of the wood-work. The dredge will draw about five feet of water with all her machinery in and ready for work.

The contractors are also building two scows, as companions of the dredge, the frame and wood-work of which is already cut out. The wood material in both the dredge and scow is strictly of pitch pine. The dimensions of the scows are as follows: Length 90 feet; width, 25 feet 4 inches; depth, 8 feet 9 inches, the bottom to be sheathed and felted. The scows will be ready in about two weeks. When both the dredge and scow are completed their cost, it is estimated, will be $45,000. The firm has a smaller dredge on the way here from Washington, where it has been dredging for two years past. They have also one of their dredges at work at Weehawken for the West Shore Railroad; one at Wicomico river, Maryland, one at Baltimore, one at Norfolk, and one at Washington, D. C., working for the Government and one at Newark, N. J. for the city.

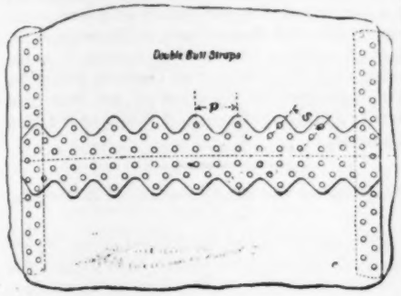
Messrs. Ross and Sanford are said to be the largest dredging contractors in the United States, and have a large amount of wealth invested in floating property.—Savannah, Ga, *Morning News*.

STEAMERS going through the Suez Canal must stop wherever the pilot gives the word, and when the sun has gone down, no matter where the vessel is, whether at a "station" or not, it must tie up at the bank. There is no risk in this, as no other steamer will attempt to go on after sundown. The pilots are a fine set of men, of different nations, English, French, Greek, Italian, etc. They dress in a simple uniform, something like naval officers in undress.

THE Illinois Central Railroad has placed on its tracks at Cairo, for incline work, a locomotive that is larger than the great Mogul engine built by the same road three years since. This locomotive, without tender, weighs fifty tons, and has engines 19 × 24 inches. On the 14th inst. some trials of its power were made. Eleven cars, loaded with wheat were started by it from a dead stop on the incline. The transfer steamer Osborne carries nine freight cars on a side, and an ordinary locomotive finds it difficult, frequently, to pull these up the hill. This engine takes up sixteen loads without delay or trouble.

Thom's Improved Boiler Joint.

We illustrate below a new form of boiler joint invented by Mr. John Tohm, of 8, Storey square, Barrow-in-Furness. The engraving shows the arrangement so clearly that very few words of explanation will suffice. The lines of rivets form zig-zags or vandykes, and the edges of the covering strip are cut to a corresponding contour in order that they may not spring away from the plate when caulked.



This disposition of the rivets permits of the minimum of reduction of the cross-section of the plate, the number of rivet holes in outer row, where the plate encounters the maximum strain, being only one-half of that of the inner rows. The joint has a strength equal to about 90 per cent. of that of the solid plate, and by its use a saving of 15 per cent. of the weight of plates can be obtained with equal strength. It has been passed by the Board of Trade for some boilers now building. The following are the formulæ by which the strength is computed:

Let t = Thickness of plate,
S = Pitch diagonally,
p = Pitch of rivets (greatest),
d = Diameter of rivets,
a = Sectional area (one rivet),
n = Number of rivets in p = 5,
1.75 = For rivets in double shear,
$\frac{11}{12}$ = For steel plates and steel rivets.

Percentage of plate to solid plate $= \frac{p-d}{p} \times 100$.

" rivets " $= \frac{n \times a \times 1.75}{p \times t} \times 100 \times \frac{11}{12}$

$S = \frac{4}{5} p + \frac{1}{10} d + d$.

Lap joints can be made in a similar manner. —*Engineering.*

A Variable Proportional Scale.

According to the *Annales des Ponts et Chaussées*, of Dec. 1884, M. Achille Thomas, C. E., has invented a variable proportional scale, useful in transferring to any one plan and scale the dimensions of a number of other plans varying in their scales.

This invention is founded upon the property, otherwise utilized in the arts, possessed by a thin strip of rubber of elongating uniformly when submitted to any desired tension.

The instrument itself consists of a wooden ruler furnished with a central groove in which slide two standards, or "head-stocks" as they would be termed in a lathe; each of these is fixed at the ends to a rack in which works a central toothed button, the manipulation of which permits motion in either direction of the length of the ruler. To these standards are attached the ends of a riband of rubber, about $\frac{1}{10}$ inch wide, upon which has been printed a decimally divided scale. As a consequence of the property of uniform elongation, before mentioned, the draughtsman is able to give these divisions on the scale any absolute value that he may desire, by simply moving the standards and thus stretching the rubber. The various divisions will always remain equal to each other.

The value of this simple and ingenious instrument is especially apparent in plotting contour lines from maps differing in scale, and it is so utilized in the Bureaus of the *Ponts et Chaussées.*

Clinton, N. Y., Water Works.

BY J. R. AND F. K. BAXTER, CIVIL ENGINEERS.

Clinton village is in Oneida Co., N. Y., and lies about ten miles south west of Utica and has a population of two thousand five hundred, and it is not a manufacturing town. Its residents are principally made up of wealthy people, students and scholars of the various schools, for which this little town is quite noted, Hamilton College being the largest and most important. Consequently the water necessary for this village is for fire and drinking purposes mainly.

The land upon which the gravity reservoir is located, lies southwest of the village about two and one-half miles, and the stream called Miller's Brook, flows into the Oriskany Creek just north of the old Chenango Canal; it is this Miller's Brook and spring that furnishes Clinton with water. It is a beautiful stream of water, and the analysis shows it to be excellent for drinking purposes. The rainfall in the vicinity of Clinton is above the average, yet this water will be used largely for domestic purposes.

The point at which the reservoir is located is 216.10 feet above the village green, (all elevations are above the coping that surrounds the old fountain in the village park). This elevation gives, at the park, a pressure of eighty-seven pounds to the square inch.

THE RESERVOIR AND DAM

is located in a shallow ravine, the southerly side of which is composed of "lime formation" which is locally called "Horse-bone Rock." But why it is so called we have never been able to determine, unless it be, from its resembling in a measure calcined horse-bone. It is exceedingly porous, though in places very dense, and it was found necessary to excavate through it, and into the red shale, which is found directly beneath, for a proper foundation on which to construct the dam.

The excavation through this material was made by blasting, and it was slow work, for it could only be done by making a vertical face before using the dynamite. Higher up in the hill, in pockets, it could be shoveled up like sand. This material was the principal obstacle to contend with in constructing a water-tight dam, which is of earth selected for the upper or reservoir site, and of coarse material, such as stones, common earth, etc., etc., to make weight for the lower or dry side, both slopes are 2 to 1.

The puddle wall is in the center and is composed of clay found in the bottom of the reservoir and adjoining lands, and is four feet wide at the base and three feet wide at the top, which is one foot below flow line, or water surface. The elevation of top of dam is 236.67 feet. The capacity of the reservoir is nearly 3,000,000 gallons to be used in case of fire and as a reserve. It covers two and three fourths acres of land, and has a depth of fifteen feet at the dam. The top of the dam is five feet above the flooring of the waste weir which crosses the dam at the extreme southerly end. The northerly side of the ravine is composed of red clay and fine shale and extends at varying depths the whole width of the ravine.

The reservoir side of the dam is protected by a slope wall of field stones laid closely together and at a right angle to the slope, at the base of which a trench was made and large boulders laid therein for the slope wall above to rest upon, thereby avoiding any chance of sliding or shifting from the effects of frost, ice and water; this slope wall is one foot thick.

Miller's Brook has its source about one and one half miles above the reservoir, and comes principally from springs. It has never been known to diminish its volume in the severest drought; the capacity of this brook the year round is 182 gallons per minute, this gives 262,080 gallons per twenty-four hours. Sixty gallons per capita was used in basing our calculations on the needs of the village, and with an average population of twenty-five hundred, (judging from the growth in the past) it is plainly evident the supply will meet the demand for many years to come.

SUPPLY AND DISTRIBUTION PIPES

were furnished by Geo. B. Hayes, of Buffalo, N. Y., for thirty-five dollars per gross ton, delivered at the Franklin Iron Works, which place is virtually the nearest point, being about midway between the village and the reservoir.

Beginning, for instance, at the reservoir, a sixteen inch pipe was laid in twelve feet lengths (as were all on this work), four hundred and five feet, then twelve inch was laid two hundred feet; then ten inch, two hundred and fifty feet, and then eight inch, thirteen thousand six hundred and sixty-five feet to the center of the village.

Distribution pipes of six and four inch are laid throughout the village, three thousand and thirty-five feet of the former, and ten thousand one hundred and sixty-one feet of the latter, which includes pipes for "blow offs" and hydrant branches.

PIPE DIMENSIONS.

	Body.	Bell.	Depth of Hub.	Weights of 12 ft. pipe.
16 in. Iron Pipe	⅝ in.	1¼ in.	3¾ in.	Lbs. 1,570
12 " "	½ "	1 "	3½ "	1,191
10 " "	⅜ "	⅞ "	3⅜ "	637
8 " "	⅜ "	⅞ "	3⅜ "	530
6 " "	⅜ "	⅞ "	3⅜ "	414
4 " "	⅜ "	⅞ "	3⅜ "	280

PRINCIPAL QUANTITIES.

6,000	cubic	yards	of earth embankment.
416	"	"	" excavation wasted.
134.38	"	"	" rock excavation blasted.
704	"	"	" puddle in center of dam.
31	"	"	" pipe trench.
71.5	"	"	" toe.
25.18	"	"	" cross.
10.16	"	"	" diagonal.
92.5	"	"	" under the waste weir.
36.6	"	"	" masonry in gate house.
23.5	"	"	" waste weir.
4.3	"	"	" pipe trench.
81.7	"	"	" reception well.
922	square	"	in slope wall on dam.
29	"	"	" waste weir.
2,934	"	ft.	timber in waste weir and gate house.

40 hydrants.
22 valves.
70 lin. ft. of 16 inch pipe mud line.
67½ cubic yards of rock not blasted.

At the usual place (near the foot of the out slope a valve house) was constructed 7 feet square, over the pipe for the purpose of regulating the supply and drawing down the water in the reservoir in order to clean the same and its bottom, should it become necessary at any time in the future. A 16 inch "K" "Y" was placed here, and two 16 inch valves, one for the supply and the other to be used in drawing down the reservoir.

The latter was placed on the limb of the "Y" with 70 feet of 16 inch light pipe leading into the old creek channel as a mud pipe or waste. To save building a costly stone well house in the reservoir as an inlet, a plan was conceived by the engineer, by which (there being but one pipe through the dam) water could be taken into this supply pipe by means of a telescope of copper sheeting ⅛ inch in thickness. The telescope is composed of three pieces, and when in position to take water, is 6 feet above the bottom of the reservoir, and shut up, and when it is thought necessary to clean the wire bonnet on top, by means of a copper cable, it is hauled up to the surface water (the telescope merely lengthening out in this operation) cleaned, and let down to its place again. It is readily handled, and is safe and economical. A valve just ahead (on the pipe) is handled by means of a long rod welded on to the valve and reaching out of the water, when down to a level of the telescope when shut.

By this valve open, and the one on the limb of the "Y" in the gate house open also, the reservoir is drawn down and cleaned, the valve on the supply pipe in the house of course during this operation being shut. Then to fill the reservoir shut both, and open the one on the main line when it is wished to supply the village.

The telescope rests in the bell end of a 16 inch "T" and leaded in, there being a wide flange riveted on the bottom of this smaller or bottom piece. The pipe through the dam was laid on a grade of 6 inches in 12 feet and upon benches or cut off walls of rubble masonry laid in cement, and one foot back of the bell end of each pipe for the purpose of true alignment and avoidance of uneven settlement at the joints. Between the walls puddle clay was introduced and thoroughly cut, the whole length of the pipe under the dam. There are five blow offs which make it very easy to let the water entirely out of the pipes in order to repair, etc, etc.

There are three 16 inch stop valves mentioned above, three 8 inch, four 6 inch and thirteen 4 inch, all of the Ludlow pattern, with extension cast-iron pipes reaching to the surface, and a cap or cover with a large "W" denoting water. There are forty double nozzle hydrants of the Ludlow pattern with frost cases, placed very nearly 500 feet apart, so that in case of fire 800 feet of hose will easily, answer all purposes.

The pipes between the reservoir and the village were all laid to easy grades as shown on a profile, so there can be but little friction from too abrupt vertical curving: great care was taken in this respect, for, it is a well known fact, that in too many cases pipe lines across the country are allowed to follow too closely the sometimes very abrupt changes of the general surface.

In the village, where the roads are all fairly graded, a general rule of four feet from the surface to the top of the pipe was strictly adhered to, the frost in this vicinity never reaching deeper than three and a half feet to three feet nine inches. Some difficulty was found in laying the pipe for about one-half a mile across the Oriskany Creek Flats, on account of the water setting back from the creek upon one side into the trench, and leakage through the towing path bank of the old Chenango Canal upon the other. This made constant baling necessary, which at best is very discouraging and disagreeable work particularly in the late fall of the year. With this exception, and a little extra trouble in crossing the Oriskany and White Creeks and the Chenango Canal twice, the digging was exceptionally good.

The work was begun on the 28th day of August last, and water was let into the pipes in the middle of the following November.

The contract price for work done and materials furnished entire, was $26,855.92. To this must be added cost of land necessary to be taken for reservoir purposes, extra work done and materials furnished, the cost in the near future (which was not estimated) of obtaining control of the water above the reservoir, building fences, etc., and extension of distribution pipes on two streets in the village, and additional hydrants, valves, etc. The only difficulty experienced by the Water Commissioners, in obtaining water rights, was by one mill owner on the Oriskany Creek, some miles below where the Miller Brook enters same. But since there is only five-sixths of one horse power in the total amount of water in the brook, estimating that the water on the wheel would give 70 per cent. of the power on the shaft (this for a fall of 12 feet) and the fall or head in the above mentioned mill being less than nine feet, and also the fact that about 80 per cent. of all the water used in the village drains naturally back into the Oriskany Creek far above the mill in question, it is quite probable the mill owner will, when he understands the question in all its bearings, claim but little if any damage. The works are owned by the village by Act, Chap. 17, Laws of 1875.

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POSITIVELY *Every Copy* of the Bismarck Bridge is sold; we will be obliged if no further orders are sent us as the money will have to be returned. The document is *out of print*, and copies are not obtainable except possibly from the officials of the Northern Pacific Ry. at St. Paul. Minn.

WE have in preparation another exceedingly valuable book "Engineering Drawings and Data of the New Aqueduct" of which only a *limited edition* is being printed, and being lithographic will not be reproduced. The drawings are from the originals in the office of the Aqueduct Commission. The price will be Two DOLLARS. A large number of copies are already sold to the Engineers and Contractors on the Aqueduct, besides an order of 200 for export. We propose to make quick work of the entire edition. They are obtainable only at this office.

AT the last meeting of the Western Association of Engineers Chicago, President Williams read an interesting paper entitled "Combined vs. Separate Systems of Sewerage as Exemplified in the Drainage of Hyde Park." This paper will probably be published in a future number of the Journal of the Associated Societies.

WE are indebted to C. C. Walcott, C. E., of the U. S. Navy Yard, at Mare Island, California for a series of most excellent photographic views of the Stone Dry-dock now about being completed at that point. These photographs were mostly taken in May, 1884, and, show the interior of the dock, from several stand-points, and the launching of the caisson on Jan. 3, 1885. As no description accompanies the views we can say little about them, except that in size this dock surpasses any now belonging to the U. S. Government; it is solidly built of stone, and is closed by a floating caisson, after the usual design of the modern dock gate.

The Chief of the Bureau of Yards and Docks, Again.

In closing up our editorial on this subject last week we expressed the hope that President Arthur would at once make the much desired new departure. But from present indications, it will fall to the lot of the incoming President to fill the vacancy. An excellent opportunity is then presented to President Cleveland and his administration to begin right, in this one appointment at least, in accordance with the civil service reform utterances of Mr. Cleveland's annual message, of Jan. 1884. In that document he, among other things, advocates "the application to the public service of the same rule which prevails in ordinary business, of employing those whose knowledge and training best fit them for the duties at hand without regard to other considerations."

This is directly in the line of the proposed reform in the selection of a chief for the Bureau of Yards and Docks, and if business principles apply anywhere it does there, in the appointment of a trained head to a purely technical department. Such appointment should have no political, personal or class signification, except such as is in the interest solely of harmony in the service, an intelligent and efficient administration of the office, and a just and proper recognition of the rights of a distinct corps of technical officers.

We have already stated the duties of this particular Bureau, and the service that should be properly expected of its chief. But, to perform these duties in the manner required by the public interest and to organize and direct a staff of civil engineering officers, special training and fitness is demanded. We would not for a moment detract from the importance of the line officer of the navy, or rob him of even a fragment of the laurels that form a grand part of our national history; but he, as does every one else, should recognize the fact, that the ability to fight a ship, or to "claw-off" from a lee-shore, does not fit the individual to pass judgment upon the "strain-sheet" of a roof truss, or to criticize the engineering details of a plan for a dry-dock. The two professions are entirely distinct, in study, training and traditions; and this being the case, the selection of a sailor for the chief of this department of civil engineering is an absurdity only to be paralleled by the placing of a surgeon at the head of the Bureau of Ordnance or a paymaster as chief executive of the Bureau of Navigation.

After a long struggle, and in the face of bitter opposition, the civil engineers of the navy are now a legally recognized corps, equal in standing to the other staff corps, and equally with these others entitled to a proper representation in the Navy Department. Their senior officer has the relative rank of Captain, and is thus eligible by law to the desired appointment, and his appointment would only be a continuance and perfection of the reform, which, from time to time in the past, has successively placed the charge of the other staff Bureaus, of Medicine, Pay, Steam Engineering and Naval Construction in the hands of the proper staff corps whose interests they represent.

Our interest in this matter is based purely upon the merits of the case and the just recognition of members of the profession of civil engineering. Seven-tenths of the members of this staff corps are members also of the American Society of Civil Engineers; and without advocating the claims of any individual of that corps, we must acknowledge the general justice of the principle involved. It is a reform demanded by the best interests of the government, and to continue the system, until now followed, is to perpetuate a method which can only work harm in the future as it has in the past. Granted that a Chief of Bureau is a necessary adjunct to that department, it would seem that the commonest business principles would suggest the selection of the man best fitted to fill that office—and this man is not an Admiral.

Progress on the South Penna. R. R. Tunnels.

After considerable ineffectual effort we are enabled, by accident rather than design this time, to present a table of general progress made in the tunnels of the South Penna. R. R. and their condition to date of Feb. 1885. While the data is not exactly official it is very near the truth. The progress is compared with the statement of Sept. 6, 1884, as published on the occasion of our personal visit about that date. The table is as follows:

Name.	Finished Length.	Progress both ends Sept. 6, 1884.	Progress both ends Feb. 1, 1885.	Length remaining to be done.
	Feet	Feet	Feet	Feet
Blue Mt.	4240	350	1610	2630
Kittatinny	4620	850	2280	2340
Tuscarora	5225	750	1967	3258
Sideling Hill	6662	860	1632	5030
Ray's Hill	3534	570	1234	2300
Allegheny Mt.	5900	1060	2230	3670
Laurel Hill	5400	700	990	4410
Negro Mt.	1050	0	100	950
Quemahoning	800	0	No record	No record

We understand that the late cold weather has brought several of the tunnels practically to a stand still by freezing up all the water courses on the mountain sides and thus cutting off the supply required by the compressors.

The Future of the Railroad.

Railroad building will receive a stimulus this year. Within the past thirty days a score or more of enterprises have been announced. Among them are a 375 mile Air Line Road, between St. Louis and Kansas City; two lines from Mobile, one north to the Tennessee, and one west to Texas, Kansas and Arkansas; a 150 mile road in Iowa; a 78 mile road in Georgia; a 300 mile road in Minnesota, besides numerous smaller lines of from 10 to 50 miles. Approximate estimate of the mileage projected since January 1st, so far as made known, is 2,000 miles. It is said by rail makers and parties in a position to be posted in such matters, that there are about 11,000 miles of projected railroad mileage. This doubtless is a modest estimate, but there are incorporated companies which have that amount at least, of railroad building projected. The plethora of idle capital and the low prices of material of all kinds, in connection with the favorable probabilities of an improving traffic, in a reasonable time, all help to nourish railway enterprises, on paper at least. How much of this projected road will be completed this year is a matter of conjecture. Investors, and managers of enterprises will take advantage of the first assurances. That widespread improvement is at hand, that railroad construction is to be pushed on a large scale, that our railway system will develop vastly from its present really

infantile proportions, that a profitable traffic will accompany and stimulate enterprise, and that the country's resources promise almost unlimited fields for future enterprise, capital and labor, are conclusions to which every intelligent mind has long ago arrived.

Our progress in railway construction shows that there is a certain relationship between railroad mileage, and the value of agricultural or manufactured products depending on this mileage for markets. An additional acre of wheat or a ton of iron, or a bale of textile products calls for additional railroad, and in a constantly increasing ratio.

The vast expansion of productive capacity which has recently taken place, and which is now in progress in spite of unfavorable conditions means in a comparatively short time, more railway facilities. Besides, railroads are a necessity, in order to enhance the values of lands, minerals, and timber, as well as lands and properties already benefited. Indulging these necessities will stimulate railroad construction sooner than the surface necessities seem to indicate. One million dollars worth of railroad will enhance values say two, five or ten million dollars, open up opportunities for immigration, create opportunities for capital, and work for labor. These mighty necessities will brook no great delay. They will drive enterprise as well as stimulate and reward it. The vast undeveloped or partly developed areas in all sections of the country will soon cry for, and demand, the stimulating and energizing influences of the steel rail. Negative reasons could be given. Our expected export trade will prove disappointing. Enterprise will be compelled to look at home for employment and profit.

The advantages heretofore arising from a concentrated industrial capital, and especially in large manufacturing centres or cities are gradnally disappearing. Men are finding out that they can manufacture as profitably one hundred or five thousand miles, remote from older and well established centres. This liberty to scatter manufacturing enterprise will create a demand for land in more remote localities, and this demand will be one of the underlying influences calling for greater and earliest railway construction. Besides, coal is being found everywhere almost; water power is abundant; small motive power is being cheapened; wind mills are multiplying; in short, without dwelling too long on the evidence of decentralizing tendencies, it is not difficult to see that the necessity for men to herd in large numbers for manufacturing and productive purposes are becoming less and less urgent. The railroads make long hauls as cheap as short ones; the telegraph makes communication cheap; power is being cut up in small sizes to suit requirements; even farmers use steam and wind where a few years ago, such utilization was not thought of.

Results justify this reasoning and its conclusions. Scores and hundreds of small manufacturing concerns are springing up, here, there and yonder. Coal in Manitoba and in the nearer north-west is attracting mechanics, and soon a host of petty industries will follow. Water power, near coal, lumber and minerals attract manufacturers of textiles, of iron and steel and of a large number of products.

The net result of these influences and factors is, that railroad building will be driven to vaster dimensions by an underforce, the evidences of which have been faintly outlined above. The masses are in need of land, air and opportunity. Human nature and human beings have been too closely caged for generations. Their energies have declined in vigor and healthy action. Railroads will permit freer circulation of the world's human molecules. There is an immense latent human energy everywhere, which, could it be computed in dollars and cents it would be enormous in volume. The sin of permitting so much human energy to die, will not remain unatoned for; the necessities of the hour are creating opportunities for the undeveloped and latent energy of the masses, at home and abroad to work, think, act, struggle, acquire, accumulate, and thus not only build up a country, but build up a higher species of manhood, than it has ever been possible under the hedged-in and oppressing conditions, which until a generation or two has surrounded so large a number of the human family. Railroad building, cheap travel and the opportunity to occupy and cultivate cheap land, lie at the basis of the grand physical and moral development of all who choose to take advantage of these elements and opportunities.

The Enlargement of Drill-holes in Rock Excavation.

M. M. Wickersheimer and Pech, mining engineers, in the *Annales des Mines*, outline a new process for enlarging the bore-holes in rock excavation so as to hold a larger amount of the explosive. It consists in first drilling two parallel holes to an equal depth and of any desired distance apart; the one hole is then charged lightly and the other left empty and the charge exploded. The separating wall is thus broken to the height of the charge only. By repeating this operation a chamber of any desired volume is obtained. The holes are cleansed by a strong stream of water forced in by a hand-pump. The ultimate result is the reduction of the total number of drill-holes, whatever may be dimensions of the heading; and, owing to the distances separating the chambers, the drilling for all can be done simultaneously.

PERSONAL.

ISAIAH B. HOUPT, a well-known contractor and bridge builder, died at Norristown Feb. 19, after a lingering illness of paralysis, aged 67 years. He was born in Plymouth and served an apprenticeship as a stone-mason. He built locks at Cumberland, Md., and assisted in setting two heavy stationary lifting engines of the inclined plane on top of the Allegheny Mountains. He built aqueducts at Huntingdon and Newton Hamilton, a prison at New Orleans, the Crane Iron Works near Allentown, furnaces at Spring Mill and Conshohocken, and dozens of bridges in his county.

JOSEPH F. TUCKER formerly General Traffic Manager of the Illinois Central Railroad Cen- and lately Arbitrator of the California and other pools, has announced his acceptance of the position of Assistant General Manager of the Chicago, Milwaukee and St.-Paul Railroad. This is considered as rendering it certain that Mr. Roswell Miller, the present Acting General Manager, will be given the permanent position as successor to the late General Manager Merrill

WILLIAM C. KINGSLEY died at his home in Brooklyn, N. Y., on Feb. 21. MR. KINGSLEY was born on his father's farm in Franklin County, N. Y. in, 1833; at the age of 18 he became bookkeeper to his elder brothers, who were then engaged in the construction of the Penna. R. R. in Westmoreland Co., Pa. After that he taught school for a time in the same neighborhood, and there made the acquaintance of Col., John O. Snodgrass, a wealthy contractor, and was engaged by him as bookkeeper in the building of a canal in Wyoming Co. On this work over 1500 men were employed, and in the frequent faction fights between the Irishmen, young Kingsley displayed so much personal courage and good sense that he was appointed general superintendent of the works. He was then associated with Col. Snodgrass in the construction of a tunnel in the Allegheny Mts. between Altoona and Johnstown, and on the completion of that work went west and built 75 miles of railroad in Wisconsin and Illinois.

About 1856 he came to Brooklyn, where until the time of his death he continued to be a commanding figure among the public men of that city. By a sub-contract from Wells & Co., the principal contractors, he built a portion of the Brooklyn Water Works, and in partnership with Abner C. Keeney, in three years, constructed 65 miles of sewers in Brooklyn, besides attending to a quantity of railroad and bridge work elsewhere.

MR. KINGSLEY was perhaps best known by his early connection with the East River Bridge enterprise. It was before him that Col. Julius W. Adams, C. E., laid his plans for that structure in 1865, matured after ten years study, and MR. KINGSLEY pronounced them practicable, from a business stand point, and entered heartily into the project. This enterprise took definite shape in 1867, and to the energy of the firm of Kingsley & Keeney the trials usual to the launching of so gigantic an enterprise were successfully passed through. It was mainly through Mr. Kingsley's instrumentality that the late John A. Roebling was appointed Chief Engineer, and after Mr. Roebling's death MR. KINGSLEY became the Superintendent, for which service he is reported to have received a commission of five per cent. on the cost of the work to a point 3 feet above the water level. In 1882, he became the President of the Bridge Comm., on the death of Henry C. Murphy, and only resigned this position a few months ago. MR. KINGSLEY was an astute politician, and his estate is reckoned among the millions. Jay Cooke Kingsley, M. E., is his son.

American Society of Civil Engineers.

The next meeting of the Society will be held at the Society House, on Wednesday, March 4th, 1885, at Twenty o'clock, (8 P. M.)

Ballots for the proposed amendment to the Constitution will be canvassed. Business will be transacted.

A paper on "The New Cantilever Bridge, at Niagara Falls" by Charles C. Schneider, M. Am. Soc. C. E., will be read and discussed.

The Library and Conversation Rooms are open *each* Wednesday Evening from 7.30 to 10 o'clock.

Collation. As has been done during the past year a Collation, to which all members are invited, will be served after the adjournment of the meeting. This Collation is provided by subscription of some of the resident members.

Meetings of the Society.—The regular meetings of the Society during the past year have been well attended. The Board is glad to say that the number of members of the Society not resident in New York who have found it possible to be present at these meetings has been large. An experiment has been tried, at the suggestion of some of the members, of providing, on the occasion of the meetings on the first of each month, a collation after the meetings, in order that pleasant opportunity for conversation should be given. The result of the experiment seems to be satisfactory. These collations are, of course, not paid for from funds of the Society, but are provided by the voluntary subscription of resident members.

Boston Society of Civil Engineers.

A regular meeting of the Society was held on Feb. 18 1885, President G. L. Vose in the chair and twenty four members present. Notice was received of the death of T. E. Sickels, an honorary member of the Society and a committee was appointed to prepare appropriate resolutions.

A committee was appointed to nominate officers for the ensuing year.

Prof. Gaetano Lanza gave a description of some experiments on belting, made at the Mass. Inst. of Technology and A. F. Noyes

read a paper on the Foundation of the Pumping Engines at the Newton Pumping Station.

The Annual Meeting and Dinner of the Society will be held on March 18th, next.

Engineers' Club of Philadelphia.

Record of Regular Meeting, February 7th, 1885.

Past-President Frederic Graff in the chair; 46 members and 3 visitors present.

Mr. M. Van Harlingen presented a full description of the Phœnixville Tunnel on the Pennsylvania Schuylkill Valley Railroad, illustrated by drawings and photographs.

The secretary presented, for Mr. A. Harvey Tyson, a paper upon the Sources of Pollution in Storage Reservoirs, from which the following is extracted:

"As City Engineer of the City of Reading, my experience concerning the subject of this paper is gathered from my connection with its water works. Previous to the year 1880, during which the Antietam Lake, with a storage capacity of ninety millions of gallons was constructed, the supply of the town was small. Citizens were satisfied with water of any kind—it was not a matter of quality but of quantity. There was an additional grumble about the condition of the water served consumers, but in a few days the impurities would disappear, and the state of public opinion would return to its normal condition. During the construction of the dam named, there was quite a perceptible increase in the impurity, as the water had a woody taste, and when left standing for five hours or more emitted a very disagreeable odor. This was attributed to the fact that the banks of the stream passing through the dam, and the flows of which were to be impounded, had been cleaned and grubbed. The bad taste and odor lasted for three weeks and then ceased. About the first of August of the next year it again presented itself; this time in a worse form, the odor remaining the same, but the taste had changed, and resembled that of fish oil. The suggestion was made that there was a deposit of filth in the pipes, and with a view of removing such, if it was the cause, flush valves were placed in all depression in the pipes and at the dead ends, and these, as well as the fire-hydrants, were periodically opened. This did not remove the difficulty and improve the water. The parts of the city served directly from this storage reservoir were the only ones in which this impurity was noticed. Those served from the distributing basins showed no signs of it. The entry into the latter was through fountains which threw the water to a height of seventy-five feet, thereby thoroughly oxidizing it and removing the impurities. An examination into the cause of the trouble showed that, instead of having the natural blue green color, it had a bright green, and when left standing, the impurity came to the surface and discolored it. Whenever, during the ten weeks within which the odor and taste remained, the thermometer for more than a day fell to below sixty-five or seventy degrees Fahrenheit, the impurity disappeared, to return again, when the temperature exceeded seventy or seventy-five degrees. An examination of the lake developed the cause of the trouble to be a vegetable formation, which when alive and scattered through the water, gave no noticeable taste or odor to the water but, in its decay, became highly offensive. As to what this vegetable formation was, the botanists differed. My conclusion, on a microscopic examination, was that the growth was of minute confervoid algae, whose germ was the clorophyl, or coloring matter of leaves. The plant when gathered from the surface seemed to be without disagreeable taste or odor, but when exposed to the heat and light of the sun, rapidly fermented and became very offensive. This plant, when in subsiding reservoirs subjected to the sun's rays, grows rapidly, and, when drawn into distributing pipes, the want of air causes decay and, as a result, *taint*.

With each succeeding year, the trouble has returned, grows worse and remains longer. Nor is it local in its development. The result of correspondence with over one hundred towns and cities where water is impounded proves that the trouble has shown itself in a greater or less degree everywhere, and how to avert and correct it, has been the problem worrying the hydraulic engineers. Numerous plans have been proposed, from oxidation by flows through open channels or artificial æration, to the gigantic scheme of roofing in the reservoirs to remove the effect of heat and light and so remove the cause of the development of this new but unpleasant affinity. Future experiment will demonstrate the most feasible plan—but, from experience, I would say that natural æration is the best, for the reason that the water in our small distributing reservoirs, which enters through the fountains as stated above, has always been pure.

The trouble is comparatively modern. Ponds and sluggishly moving streams, which were sweet twenty years ago as I loitered along them, are now affected in a like way, without any change of conditions. They are affected by the climatic change through which the country is undergoing. Steady rains have ceased, and the precipitation is sudden and rapid.

Chemical analyses of our affected water have shown that there is nothing deleterious to public health, although it may be exceedingly disagreeable. Examinations for the last three years resulted as follows:

	1882.	1883.	1884.
Free Ammonia,	.0028	.0027	.0035
Albuminoid Ammonia,	.0175	.0175	.0133
Chlorine,	.2900	.2950	.3000

Also with the increase of pollution from this source, there has been a corresponding decrease in the death rate, which, from the records of the Board of Health, is as follows: 1880, 20. 1 per M.; 1881, 21.0 per M. (scarlet fever epidemic;) 1882, 20.0 per M.; 1883, 19.0 per M.; 1884, 18.9 per M.

The facts as stated above, that this source of pollution is not deleterious to public health, should not allow engineers and local authorities, by an appeal to the purse, to let it pass by without some determined effort at correction, as it may tend to the development of some characteristic which would be damaging."

Mr. Chas. G. Darrach discussed the subject at length. He said:

"Data collected during the past seven years disproves the old theory that, as an approximation, we may estimate a daily average yield of 1,000,000 U. S. gallons (133,370 cubic feet) per day, per annum, per square mile of catchment area, or the utilization of 23 inch of rain-fall. In fact, but one-half this amount should be estimated. We are, therefore, forced to increase the storage capacity, to tide over dry years, calculating the average yield of 24 or 36 months instead of 12 months: in so doing, the depth of the collecting storage reservoir is increased, and it is to this point your attention is directed.

In 1875, I noticed that the water, drawn from a depth of 50 feet in Tumbling Run Dam, was very offensive in odor; but after contact with the air, the water became odorless and potable, similar to the water on the surface of the dam."

He then presented a detailed account of the similar trouble in the Baltimore water supply and his correspondence and experiments with Mr. Robert K. Martin, Chief Engineer, and concluded as follows:

"In the paper before us it is stated that while the water drawn from the pipes leading from the collecting and storage reservoir, was bad, it improved after being discharged into the distributing basins. Mr. C. S. d'Invilliers (Member of the Club) informs me that it is his impression that the collecting reservoir for the City of Reading (that mentioned in the paper) is about 70 feet deep,* and that its capacity is great compared with its catchment area. I do not remember the data of the completion of this reservoir, nor the length of time the water has been stored. It is probably two or three years. Light would be thrown on the subject did we have before us all the data as well as the plans of the reservoir.

From the data furnished by Mr. Martin, the water in Druid Lake seems to have fouled in two years, from 1881 to 1883. A theory which these facts seem to indicate is, that products of *decaying* vegetation sink to the lower water in deep reservoirs, where decomposition is suspended for want of oxygen; the gases are absorbed by the water, which gases, upon contact with the air, are fully oxidized.

As a prevention, surplus water should be wasted from the *bottom* of the deep reservoirs and not over the weirs; as a cure, *aeration* by means of shallow distributing reservoirs receiving the water on the surface and, if possible, from fountains.

In 1881 the newspapers of Baltimore stated that, as chemists had failed to discover impurities after testing the water which caused complaint, it was probably because Dame Nature had forestalled them."

Dr. H. M. Chance was of the opinion that in the great fresh water lakes we had conditions analogous to those present in artificial storage reservoirs, and therefore asked if any member could tell whether any examinations had been made into the conditions of the water at considerable depths. If this was found to be fresh and of good quality, similar, in other words, to the surface of these lakes, then an inquiry into the conditions which protected it from contamination, or purified it, would be of great value; but if, on the other hand, the water at great depths was found contaminated in the same way as that in storage reservoirs, then it would be useless to look for any natural phenomena to assist in purifying stored water, and reliance must be placed upon some artificial method. He believed the subject was of sufficient importance to warrrant an immediate investigation into the character of the deep water of these great lakes, and thought that, until this was done, sanitary engineers, in declining to avail themselves of this knowledge of natural laws were committing a great mistake and were necessarily working in the dark.

The secretary announced the death of our fellow-member, Mr. D. Hudson Shedaker, and asked that a committee be appointed to prepare a Memorial for the Proceedings.

HOWARD MURPHY,
Secretary and Treasurer.

CORRESPONDENCE.

The Water Jet in Engineering Construction.

PHILADELPHIA, Feb. 21, 1885.

EDITOR ENGINEERING NEWS.—In speaking of the Water Jet as an aid to engineering construction, an additional example to those given in your issue of Feb. 14, is its use in the Government work on the western rivers.

In 1881 a large number of piles were sunk by this means in the Missouri River near Leavenworth.

The leads were placed on a rectangular barge, to which the ends of two narrower and longer barges were rigidly attached. These last were parallel and the piles were driven in the space between them, the side of one of the barges being used as a guide in locating the apparatus as well as in sinking the piles. The leads were so arranged that the pile could be directed at any desired angle. The water pipe was carried down the side of the pile into which it was sunk by means of

* The Secretary has since learned from Mr. Tyson that the Reading reservoir is 40 feet deep and water is drawn at three depths: 12, feet, 24 feet and 36 feet. Mr. Tyson adds: "Thinking that the defect in our water was caused by the draft (through the defective construction of the valve tower) of bottom water, an outside standpipe, with valves at the same height as above was constructed this autumn. What the result will be, next summer must demonstrate."

a notch near the lower end (which was left square). When the jet was in operation the weight of the barges was brought to bear on the pile by means of a tackle, windlass and engine.

The fine sandy bottom of the Missouri and Mississippi Rivers would seem especially adapted to the use of the water jet in sinking piles, provided they are long enough to reach below scouring action of the current. Whether the above apparatus is still in use I do not know.

K. ALLEN.

Grade for Side Tracks.

ATLANTA, GA., Feb. 20th, 1885.

EDITOR ENGINEERING NEWS.—Would like your correspondents or yourself to answer if 6 tenths grade in a 100 feet is too steep for side tracks. This is very desirable to know accurately as the question of lowering tracks through Atlanta's important streets and bridging the highways over is involved. Will the friction counterbalance gravitation on that inclination? Would like examples.

Yours,
H. T. MCDANIEL,
Asst. Eng., Atlanta, Ga.

Urbana, O. City Engineer.

URBANA, O., Feb. 23, 1885.

EDITOR ENGINEERING NEWS:—In your issue of Feb. 14, 1885, you have. "New City Officials—Urbana, O. is to have City Commissioner and a City Civil Engineer."

Would state as a correction that we have had those offices for the past twenty years, but they have been elective offices.

One of our Councilmen is trying to have a bill passed through the Legislature to have the same offices filled by appointment of the City Council.

Respectfully yours,
W. H. L. TAYLOR, City Civil Engineer.

Problem in Bridge Construction,

P. C. & St. L. R. R. Co., PITTSBURGH, PA., Feb. 22, 1885.

EDITOR ENGINEERING NEWS:—In answer to questions by Mr. H. A. Young in Feb. 14th number of your valuable paper:

1st. The corbel does strengthen the stringer by furnishing better bearing surface than can be obtained by placing the stringer directly upon the cap.

2nd. The corbel should not be considered in calculating the size of stringer needed. By inference, this answers the second part of question.

3d. There would be no economy to build a trestle using a packed stringer of larger dimensions instead of using a corbel, but for economy and durability, use plain sticks for stringers, and by all means corbels.

Respectfully,
F. DARLINGTON, Engr., M. A.

Plate Girder Bridges.

LOS ANGELES, CALIFORNIA, Feb. 10, 1885.

EDITOR ENGINEERING NEWS:—In a recent issue of your journal you published a most excellent article on the subject of Plate Girder Bridges, from the pen of M. J. Becker, Chief Engineer P. C. & St. L. R. R. In that paper are many valuable suggestions as to the practical application of the principles involved in the design and actual construction of this class of structures.

Mr. Becker very properly refrains from any extended discussion of the theoretical stresses or their calculations; but, as it is always in order to view an engineering question from a theoretical as well as a practical standpoint, I offer no apology for presenting in this connection the following proof of one of the principles used in the determination of stresses in girders of this class.

In an extensive course of reading on this subject, I do not now recollect ever having seen an analytical proof of the one principle or fact forming the text of this letter; though I have seen it fully demonstrated in works on Graphical Statics. I believe it will be of interest to some of your readers, at least; to others it may prove old and elementary matter.

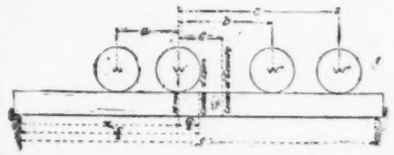
The principle, to which I refer, is, of course, well known to the designers of bridges or structures intended to sustain moving loads. It is also usually stated as a principle in the majority of works on bridge construction and mechanics, but without the demonstration.

The principle may be stated as follows:—If, on a girder supported at the ends, we pass any number of equal or unequal loads, at given distances apart, then the maximum bending moment in the girder will occur under one of the loads situated nearest the center of gravity of all the loads combined; and the center of span of the girder will be exactly midway between the center of gravity of all the loads combined and the point of maximum bending before mentioned.

Stated as a problem it would stand thus; Given: a girder supported at the ends, with any number of known, equal or unequal, loads at fixed distances apart passing thereon. Required:—the exact position of the loads on the girder, such that the bending moment in the girders shall be a maximum.

I will use a girder with four passing loads, this being the familiar case of an ordinary locomotive moving over a girder. The proof is general and the principle applies to any number of equal or unequal loads greater than one.

The following sketch will illustrate the general conditions:—



Before proceeding with the demonstration, let us find an expression for the distance of the center of gravity, of all the loads combined, from the center of the load or wheel marked W', this being one of the loads nearest the said center of gravity.

Let G = this last described distance. Let W = the first load or wheel, counting from the left hand abutment. Let W' = second, W'' = the third and W''' = the fourth load. Also, a = distance from the second load to the first; b = distance between second and third wheel, and c = distance between second and fourth wheel or load. Then the distance represented by G will stand thus:—

$$G = \left(\frac{W'' b + W''' c - W a}{W + W' + W'' + W'''} \right) \qquad (1)$$

Now, let, M = the bending moment.
S = the span of girder.
x = the distance of second load W' from left abutment.
R = the reaction of left abutment.

Then the expression for this reaction, in terms of a, b, c, x, S and loads, will be:—

$$R = \frac{W}{S}\left(S-(x-a)\right) + \frac{W'}{S}(S-x) + \frac{W''}{S}\left(S-(x+b)\right) + \frac{W'''}{S}\left(S-(x+c)\right) \qquad (2)$$

and taking moments around a point under the second load W', we have for the expression of the bending moment in foregoing terms:—

$$M = Wx - \frac{Wx^2}{S} + \frac{Wax}{S} + W'x - \frac{W'x^2}{S} + W''x - \frac{W''x^2}{S} - \frac{W''bx}{S} + W'''x - \frac{W'''x^2}{S} - \frac{W'''cx}{S} - Wa; \qquad (3)$$

Differentiating this equation, we have, after dividing by dx:—

$$\frac{dM}{dx} = W - \frac{2Wx}{S} + \frac{Wa}{S} + W' - \frac{2W'x}{S} + W'' - \frac{2W''x}{S} - \frac{W''b}{S} + W''' - \frac{2W'''x}{S} - \frac{W'''c}{S} \qquad (4)$$

Putting this value of first differential coefficient equal to zero; re-arranging and transposing known terms to second member of the equation, we have'—

$$\frac{2}{S}\left(W + W' + W'' + W'''\right)x = \left(W + W' + W'' + W'''\right) - \frac{1}{S}\left(W''b + W'''c - Wa\right)$$

whence

$$x = \frac{S}{2} - \frac{1}{2}\left(\frac{W''b + W'''c - Wa}{W + W' + W'' + W'''}\right) \qquad (5)$$

Now it will be observed that the quantity in parenthesis is the *same* expression that we found for the value of G, that is:—

$$x = \frac{S}{2} - \frac{G}{2}.$$

This value of x makes M a *maximum*, which was to be proven.

If in equation (5) we substitute *two* unequal loads, W and W', for the four loads, and a being equal to the distance between them, their combined center of gravity, with reference to center of W, would be:—

$$G = \left(\frac{W'a}{W + W'}\right)$$

And by taking moments around W, instead of W, we would have;—

$$x = \frac{S}{2} - \frac{1}{2}\left(\frac{W'a}{W + W'}\right); \text{ or,}$$

$$x = \frac{S}{2} - \frac{G}{2}, \text{ as before.} \qquad (6)$$

If the two loads are equal, then their combined center of gravity would be midway between them, and we have:

$$G = \left[\frac{Wa}{2W}\right] = \left(\frac{a}{2}\right).$$

and equation (6) becomes;

$$x = \frac{S}{2} - \frac{1}{2}\left(\frac{a}{2}\right), \text{ or}$$

$$x = \frac{S}{2} - \frac{a}{4}.$$

The demonstration is thus shown to be true in all cases.

Respectfully,
FRANK C. DOBAN, C. E.

John Ericsson's Destroyer.

The Senate Naval Committee has advised the purchase of Capt. John Ericsson's Destroyer, for $120,000, with the privilege of buying also the patents relating to this vessel for $100,000 more.

The Destroyer may or may not be the type of vessel needed for fighting huge hostile ironclads; but at least its designer's reputation, his long connection with the navy, and his inestimable services to the country in producing the Monitor and her successors, demand that his new system of seaport protection shall not be treated with neglect.

The Ericsson system of harbor defence is that of carrying submarine artillery in small cheaply-constructed vessels. The gun fired under water is the central factor; the vessel is only the gun carriage, The Destroyer is 130 feet long, 17½ wide, and 11 deep, Her bow is protected by heavy, inclined armor plates, placed transversely, and backed by thick timbers. Within the iron hull an intermediate arched iron deck extends from stem to stern; under this is the powerful engine, and there also are the crew during action Under the iron deck and the inclined armor of the bow is a 16-inch gun, 30 feet long; it carries a projectile 25 feet long, weighing 1,450 pounds including an explosive charge of 300 pounds of gun cotton. This gun is near the bottom of the vessel, and its muzzle passes through an opening in the stem. A valve, opened and shut by steam power, covers this muzzle and when it is raised the inrushing water is checked by an inner valve which is strong enough to hold in, but is itself easily carried away by the tremendous projectile as it leaves the bore. An inner sea valve is sacrificed for each shot,

Undoubtedly the submarine gun is limited in range. It is discharged at a distance of 300 feet from the enemy's ship, and when the projectile strikes the ship its charge of gun cotton is exploded by a percussion firing pin. A spiral spring prevents this explosion from occurring on the initial and comparatively trivial percussion against the inner valve of the gun. The theory of the vessel is that it can be safely brought, on account of its thick armor, within a range of 300 feet, and that a charge of 300 pounds of gun cotton, there delivered against the vulnerable parts of an ironclad, under water, will shatter the hull.

Thus far the opinion of naval officers has differed in regard to the Destroyer. Great hopes of it have been entertained by some, while others have interposed objections. From the conflicting official opinions and reports of trials the Senate Naval Committee has collected sufficient testimony to recommend the purchase of the Destroyer.

An engineer 82 years old might well insist that the Government should either take his work or else decide not to take it, in order that it may be disposed of elsewhere. Still, the question, after all, is not necessarily that of buying this particular vessel, inasmuch as Capt. Ericsson has offered, for $160,000 to

build a steel vessel like the iron Destroyer, a trifle larger in each dimension, with submarine gun and projectiles complete, and to guarantee the stipulated performance of both vessel and gun by sureties who would be fully responsible in case of failure.—*N. Y. Sun.*

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from page* 126.)

In use the rib should be on the outside. The throw of the switch is the distance between the centres of the stub rails and is almost always for standard gauge 5 inches. The distance between the ends of the stub and moving rails varies with the season. It should be in excess of the width of the dividing partition about ¾ inch to 1 inch in winter, and 1 inch to 1½ in summer. The switch stand or the apparatus by which the power is applied to throw a switch also admits of a variety of designs. The old "harp" pattern Fig. 63 is still

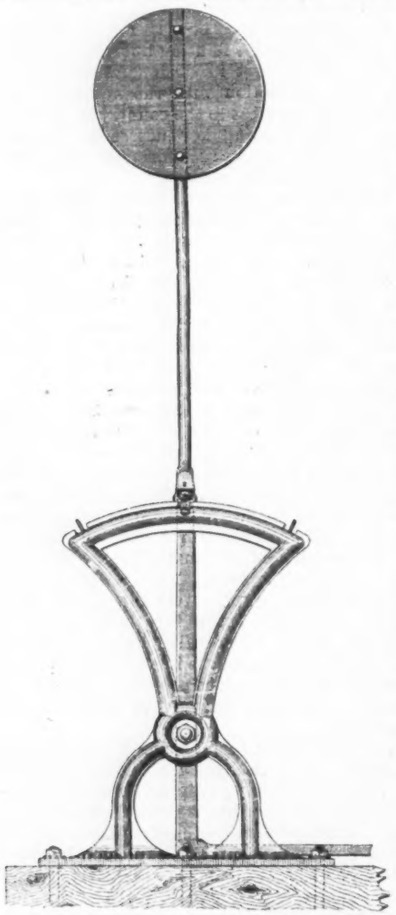


FIG. 63.—"HARP" SWITCH STAND.

considerably used, especially on old roads, but it is very awkward and liable to injure a switch man should it hold hard and then suddenly slip.

(TO BE CONTINUED.)

COL. DEMING N. WELCH, formerly General Superintendent of the Pullman Car Company, died in Dresden on Feb. 11, inst. He was a great favorite among railroad men. He entered the service of the Pullman Company in 1871 as Assistant General Superintendent, assuming control as General Superintendent the following year, holding the position until 1880, when he was compelled to resign on account of ill health. He was 44 years old and the son of H. M. Welch, President of the First National Bank of New Haven, Conn. He was unmarried.

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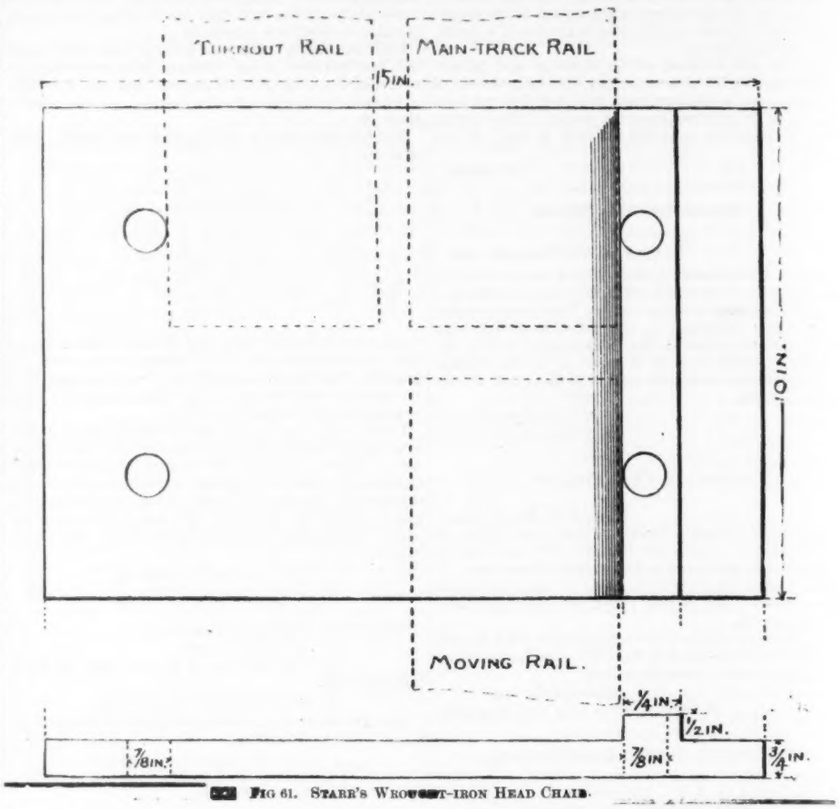

FIG 61. STARR'S WROUGHT-IRON HEAD CHAIR.

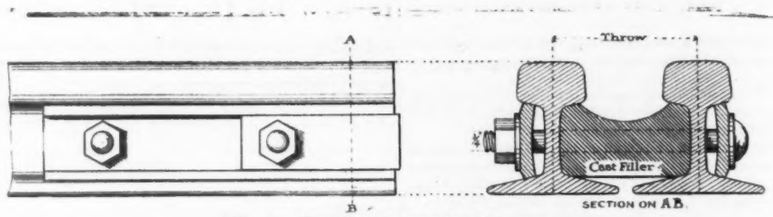

FIG. 62. CAST FILLER FOR STARR'S CHAIR.

Sewerage of Atlantic City.

No epidemic disease has ever prevailed at Atlantic City. The sanitary measures are in the hands of a Board of Health, the members of which fully appreciate the responsibilities of their position. Pure drinking water is introduced from the interior, and a system of sewerage is now being provided, which promises to prove a most potent factor in preserving the health of the growing town. The topography of the town does not admit of natural drainage, and formerly the refuse and waste were carted off by contraci. This plan proved unsatisfactory, and it was determined to employ some more effective methods. A commission was appointed to examine various systems of drainage, and devise the best possible plan from such as had worked effectively elsewhere. The committee studied the question with care, and chose as the best what is known as the "West System." By this method the waste and sewerage are forced through pipes to a central reservoir, and thence pumped out to a point beyond the corporate limits, where, by the aid of machinery, the solid substance is converted into phosphates, and the liquid, purified by filtration, is allowed to flow into the bay. This is a most effective method and one that has been used with great success in this country and in Europe. The work of laying the pipes is being pushed forward with vigor by a New York firm, and the early completion of the early completion of the work is confidently expected.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E. : M. INST. C. E

Continued from page 126.

DCCXXIV GRANVILLE, N. Y.

Granville, Washington Co., New York, in lat. 43° 30′ N., long. 73° 30′ W. is on the Mettowee River.

Settled about 100 years ago, it has never been incorporated. Water-works were built in 1884 by a private company, after plans of S. C. Randall, taking the supply from the Mettowee River which is the outlet of Lake St. Catherine. A dam 20 feet high and 200 feet long forms a storage reservoir and also furnishes the power to drive the pump. After being filtered through a wooden box 30 feet long, 10 feet high, and 10 feet wide, filled with sand, gravel and charcoal, the water is pumped by a Knowles pump of 14 inch water plunger and 16 inch stroke, lifting 100 feet to a wooden tank 14 feet in diameter and 20 feet high, 50 feet above the highest part of the village. By direct pumping a fire pressure of 100 lbs. is obtained.

Distribution is by 6 inch cast-iron pipe with 12 fire-hydrants, 5 gates and 100 taps. Service pipes are of black iron. The village does not pay for fire service. The works have cost about $9,000. The population in 1880 was 1,071 and is now given as 1,500. Messrs. Finch, Stevens and Potter own and manage the works.

DCCXXV. GRASS VALLEY, CAL.

Grass Valley, Nevada Co., California, in lat.

38° 30′ N., long. 119° 40′ W. is in a mining, lumbering and manufacturing district.

Settled in 1849, it was incorporated a town in 1854. Water-works were built in 1865, by the town taking the supply from the Yuba River. The water is brought six miles in an open ditch to a reservoir holding 50,000,000 gallons and being 210 feet above the town.

Distribution is by 10 miles of cast-iron pipe of 6 and 4 inches diameter, with 64 fire hydrants, 14 gates and 450 taps. Service pipes are of wrought-iron. The daily consumption is 425,000 gallons. The population in 1880, was 6,688. The works have cost $80,000.

The yearly expenses of maintenance are, $6,000 and the receipts $8,000. J. J. Dorsey, is Superintendent.

DCCXXVI. HAILEY, IDAHO.

Hailey, Idaho, in lat. 43° 30′ N., long. 116° W., is the county seat of Alturas Co.

Water-works were built, by a private company in 1884, the supply being taken from Indian Creek. The water is conveyed to a reservoir 110 feet above the town and is thence distributed by 2 miles of wrought-iron pipe with 5 fire-hydrants and 70 taps. Service pipes are of wrought-iron. The town does not pay for fire service. The works have cost $15,000. There is no bonded debt. The yearly expenses of maintenance are $500, and the receipts $3,600. E. A. White is manager of the works.

DCCXXVII. HARBOR GRACE, N. F.

Harbor Grace, Newfoundland, in lat. 47° 41′ 27″ N., long. 53° 12′ 33″ W. is on the west side of Conception Bay, which forms a harbor 6 miles long from 1 mile to ½ mile wide.

The town was settled about 300 years ago and has never been incorporated.

Water-works were built by a private company in 1863 after plans and under the superintendence of James Fenwick, the supply being taken from Bannerman Lake, which has an area of 1½ square miles and drains a water shed of about 20 square miles. At the south east end of the lake an earth dam is constructed through which a 20 inch cast-iron pipe conveys the water from the supply box in the lake to a reservoir 8 feet long, 4 feet wide and 12 feet deep, constructed of iron, holding 2,880 gallons and being 260 feet above tide water.

Distribution is by 5 miles of cast-iron pipe of 15 to 2½ inches diameter with 38 fire hydrants and 102 taps.

Service pipes are of lead. There are no meters in use.

The town pays nothing for fire service, nor for 28 public fountains which run at all seasons.

The capital stock of the company is $52,400, which is the amount of the bonded debt at 5 per cent. The payment of which is guaranteed by the Government.

The works are managed by a board of 7 directors, 6 appointed by the stock-holders and 1 by the Government. The population is 5,000. Claudius Watts is Secretary and Collector, and John Lynch Superintendent.

DCCXXVIII. HEMPSTEAD, N. Y.

Hempstead, Queens Co., N. Y., in lat. 49° 45′ N. long. 73° 30′ W. is on level ground on Long Island 21 miles from New York City.

Water-works were built in 1880 by a private company taking the supply from ground water. From a well 50 feet in diameter and 30 feet deep the water is pumped by a Worthington Duplex Pump of 14 inch steam and 7 inch water cylinders and 10 inch stroke, and one Knowles Pump of 14 inch cylinders and 9 inch stroke, to a tank 30 feet in diameter and 11 feet high, raised 75 feet above the surface of the ground.

Distribution is by 5¼ miles of cast-iron pipe with 24 fire hydrants and 2 taps. Service pipes are of wrought-iron.

There are no meters in use. The town does not pay for fire service. The daily consumption is 180,000 gallons. The population in 1880 was 2,521.

The works have cost $30,000. The yearly expenses of maintenance is $500. The receipts are not stated. J. Bayard Backus is President of the company.

DCCXXIX. IDA GROVE, IOWA.

Ida Grove, Iowa, in lat. 42° 20′ N., long. 95° 30′ W., the county seat of Ida Co. is on the Maple River.

Settled in 1878 it was incorporated a town in 1879.

Water-works were built in 1882 by the town after plans of Wm. H. Burnham taking the supply from ground water. Five driven wells connected by a common 3 inch suction pipe, and one open well 8 feet in diameter and 18 feet deep furnish the supply. The water is pumped by a double acting pump of 4 inch bore and 18 inch stroke driven by a wind-mill 25 feet in diameter, made by the U. S. Wind Engine and Pump Co., to a wooden tank 20 feet high and 30 feet in diameter, holding 99,200 gallons, set on a timber trestle 20 feet high. The bottom of the tank is 100 feet above the business portion of the town and 1800 feet distant from the pumps. A Knowles Pump of 12 inch steam and 6 inch water cylinders and 12 inch stroke is also used in calm weather, and for direct pumping in case of fire.

Distribution is by 1.3 miles of cast-iron pipe of 6 to 4 inches in diameter, with 11 fire hydrants, 3 gates and 48 taps. There are no meters in use. Service pipes are of wrought-iron. The daily consumption is 12,000 gallons. The population in 1880 was 759 and is now said to be 1,503.

The works have cost $10,380. The bonded debt is $7,500 at 5 per cent. The total receipts to August 1, 1884 have been $1,185. The expenses of maintenance in 1883 were $375, and the receipts $585. A board of three Water Commissioners manage the works. G. A. Case is Chairman.

WATER.

THE Wahpeton, Dak., water bonds have been legalized.

QUITMAN, GA., authorities have just closed a contract for an artesian well. A new railroad is also projected.

THE Ohio Legislature has passed the Senate Bill authorizing Ravenna to issue bonds and construct water-works.

MARTIN'S FERRY, Belmont, County, Ohio has been authorized to issue bonds to build water-works. Also Ravenna, O.

THE subscriptions to the stock of the Laconia Belknap Co., N. H. water company amount to $50,000, leaving only $10 000 to be taken.

CLEVELVND, O.—Of 16 inch pipe 9,740 feet will be required between Woodland Hill, and Wilson Avenues, and this will cost $29,220. Twenty miles of 8 inch pipe will also be necessary, at a total cost of $137,280.

DEAN BROS. STEAM PUMP WORKS, Indianapolis, Ind. have orders for the new pumping machinery, consisting of six duplex steam pumps for the new blast furnaces at Dayton, Tenn. This furnace is being built by a company of Englishmen headed by Titus Sault.

THE Water-Works Company contemplate making important extensions of their mains, this spring, if the streets are graded. The company proposes to lay a main on Montgomery avenue, on Ninth, Gilmer and Whiteside streets.—Chattanooga *Times*.

THE Covington people are anxious to obtain their water supply from Newport, Ky., and as the Newport Water-Works are anxious to receive an increased revenue to pay its expenses, it is probable that some arrangement may be perfected.

ONTARIO LEGISLATURE.—The Private Bills Committee have agreed to report the following bills with slight amendments:—An Act to amend the Acts relating to the water-works of the city of Hamilton; an act to legalize a water-works by-law of the town of Paris.

THE Maine Legislature has voted to incorporate the Artesian Water Co., to the Camden and Rockland Water Co. This gives the citizens of Rockland and Camden a new water company, and to take water from Oyster River Pond.

THE Governor has signed the bill legalizing the acts of the Water Commissioners of Clinton, N. Y. The Commissioners have expended $30,000 in building their reservoir and laying the pipe. The project was fought by T. W. Dwight, of New York, who owns property in Clinton. A suit was brought, in which the decision was in favor of Dwight, but the Commissioners appealed the case. The passage of this law ends the litigation. Had Dwight succeeded the Commissioners would have been obliged to stand the expenses of the work themselves.

MINNEAPOLIS, MINN., will advertise for the laying of pipe during the coming season. Each bid to be accompanied by a surety of $500. There are about twelve miles of pipe to be laid. The pipe will be delivered by the city, and specials will also be delivered by the city. But all other delivery that may be found necessary must be done at the contractors' expense.

THE contract with the Southwark Foundry and Manufacturing Company for the new pump for the Lake View, Ills., water-works was read and the Supervisor authorized to sign the same. It calls for two pumping-engines set as a pair and so arranged that the duplex motion may at any time be discontinued and the engines worked singly. The pump is to have a daily capacity of 5,000,000 gallons, to be completed by May 1, and warranted for two years. The cost will be $15,500.—Chicago *Tribune*.

BIDS were received for water pipe on Feb. 19th at Milwaukee, Wis.; the following shows the names of bidders, highest, lowest and successful bids.

30	inch	pipe,	$30.45,	$24.90,	$24.90	per ton.
12	"	"	30.45,	26.25,	26.25	" "
8	"	"	30.45,	26.55,	56.55	" "
6	"	"	30.45,	26.70,	26.70	" "
4	"	"	30.45,	26.90,	26.90	" "
3	"	"	30.45,	26.90,	26.90	" "

Contract for 12, 8, 6, 4 and 3-inch pipe awarded to Lake Shore Foundry; 30-inch pipe to Dennis Long & Co., of Louisville.

MR. ANTHONY MURPHY, who had much to do with the construction of the Atlanta water-works system, thinks the city should construct a reservoir and stand pipes or tanks on the high grounds of the city. Said Mr. Murphy, yesterday:

"Where is a good location for a reservoir just outside the city limits between the city and the water-works. A foundation forty to fifty feet high could be constructed out there and a reservoir be built that would hold any amount needed. Then inside the city on some of the elevations we could put standpipes or tanks and get not only a pressure, but a sure supply of water, which we have now only in the cisterns. There is much unjust complaint against the water-works. I remember when the water-works question first sprung up, the people declared they would not want it in any great quantity. But they have changed their opinion, and have tapped the mains for domestic uses, steam, etc., until we are using far more water every day than anyone, except, perhaps, a few of us, dreamed we ever would. The simple truth is, the water-works system will be all right if a little good sense can be brought to the rescue."

"What about the syndicate?"

"Of course the city is not going to part with her water-works. That is out of the question."—Atlanta *Constitution*.

NASHVILLE, TENN., PUBLIC WORKS.—The Finance Committee returned to the City Council a petition that they had prepared to submit to the Legislature, asking that they be allowed to issue bonds to the amount of $1,000,000. The bonds will be for the following objects; $500,000 of funding bonds, $200,000 of bonds for new bridge, $200,000 of bonds for water-works, $100,000 for sewers. The petition also set out the necessity for the issuance of these bonds. Adopted.

Bills appropriating $65,000 for an island filter passed second and third readings.

Bill increasing salary of City Engineer passed second reading.

Bill appropriating $2,500 for water meters passed second reading.

Bill authorizing the Board of Public Works and Affairs to employ a draughtsman, rodman, etc., passed third reading.

A bill authorizing the appropriation of $164,737, to lay the force main pipe from the new water-works plant, passed third and last reading.

A bill authorizing the appropriation of $13,200, for laying a crib at the upper island, and a suction-pipe therefrom, passed third reading.

A bill authorizing the appropriation of $8,000 for the improvement of Brown's Creek passed its third reading.

A bill authorizing the appropriation of $80,000 for the purchase and construction of a new pumping station at a point near the upper island passed third reading.—Nashville *American*.

INDIANAPOLIS WATER-WORKS.—Under the efficient and businesslike management of Mr. F. A. Davis, the Indianapolis Water Company has been brought to a more prosperous condition than ever before in its history. The dam at Broad Ripple, which turns water into the canal which furnishes water-power to drive some of the machinery, has been put into good condition and the canal itself repaired. The pumping machinery

which comprises two large Holly steam pumping-engines, besides the water-power pumps is in excellent condition. About three miles of additional pipes were laid last year, showing a gratifying increase of the company's business. There is no excuse now for the people of Indianapolis continuing to drink their dangerous well-water, for the water company furnishes water of excellent quality from their gallery supplied by ground-water. The stupid blunder made in constructing an open instead of a closed gallery, and in making the slopes so steep that they wash in and fill up the bottom, which has to be dredged out from time to time, continues to cause annoyance, but it is likely that this will be rectified in time and the original design of the engineer, a covered gallery, carried out. With such a gallery, extended from time to time as needed, these works may be made among the best in the country.—*Sanitary Engineer.*

FREEZING OF WATER PIPES.—"An English Sufferer" writes to the Toronto *Mail*—"Instead of all this fuss about the water taps being left running would it not be better that the authorities should take some steps to see that the water pipes in all newly erected houses be so laid and protected from the frost that there would be no need for having the taps turned on? It is all very well to draw attention to the water famine which is said to be threatening Toronto by the breaking down of an engine, but would it not be more to the purpose to prevent the water pipes freezing. Directly I turn off my taps the water freezes, and it is hours before I can thaw them out, and it is only by keeping the water always running in my bath-room that I can get water at all. If the authorities mean business, let them appoint some responsible inspectors who shall see that the pipes are properly packed and protected when the buildings are put up. This would be infinitely preferable to the plan now adopted of making a sudden raid on the occupants of thin, wretchedly built shanties."

There is a great deal of truth in "Sufferer's" letter. The foundation of the trouble in many cases is that the services are carelessly laid, being exposed to the frost, when they should be laid specially with a view to the inclemency of our winters. But this cause does not cover all the cases of waste by any means. Instances are known where the taps are left open all night although the premises are supplied with a waste tap, which if used intelligently would render freezing impossible. In a number of cases the commonest principles of water supply seem not to be understood. And in this connection it might be suggested that the Water Works Department might get up a card or little pamphlet containing simple rules in relation to waste taps, the emptying of the pipes after the waste tap is shut, the principles of hot water heating, etc. If this were done fewer cases of freezing pipes, bursting stoves, and such like domestic casualties would be heard of.—Toronto *Mail.*

THE KNOXVILLE, TENN., WATER-WORKS.—The *Chattanooga Times*, of February 2, is responsible for the statement that "an early investigation is to be made into the contract between the city of Knoxville and the Knoxville Water-works Co." The same article claims that there is not sufficient water in the reservoir to meet the demand contracted for; that the reservoir is not large enough in time of fire; that the mains are too small; that the head or pressure is insufficient, etc. We have submitted this statement to Mr. M. T. Davidson, who built the pumping machinery, and to Messrs. Lockett & Fuller, the engineers in charge of the construction, and obtained from them the following data:

The Knoxville works were built by the Knoxville Water Co., under a contract with the city. The plans and specifications, in all their details, were made by the late Moses Lane, C. E., of Milwaukee, in 1878, when the city intended to build the works itself. When the original project failed and a new contract was made with the present company, in 1882, these plans and specifications of Moses Lane were made a part of the contract; the sites for reservoir and pumping station were both designated, and all the details of these plans were exactly carried out, with the exception of the substitution of a "by-pass" for a small 35 ft. stand-pipe originally proposed for an increased fire pressure. This contract called for a pumping capacity of 2,000,000 gallons. Mr. Davidson informs us that the pumps actually put in have a capacity of 4,000,000 gallons in 24 hours, under a head of 234 feet, consequently in this direction the company has exceeded its contract. The actual reservoir capacity is 3,200,000 gallons; the size, length and weight of the mains were all carefully stated in the specifications of Mr. Lane, furnished by the city, and these dimensions were scrupulously adhered to in the distribution system. There were in this system according to the specifications, 600 feet 16 inch pipe, 2,500 feet 14 inch, 2,340 feet force main 12 inch, 4,581 feet 10 inch, 8,000 feet 8 inch, 17,675 feet 6 inch, and 9,795 feet of 4 inch pipe. Mr. Lockett, of the firm of engineers, says:—"The force main is 14 inch in diameter, 2,300 feet long, and has, in its course from the pumps to the reservoir, two right angle bends. It connects at the reservoir with a 14 inch pipe entering the settling division of the reservoir, and also with the 16 inch effluent pipe from the clear water division. Three valves are placed on these pipes, by the manipulation of which water can be pumped into either division or entirely by the reservoir and delivered into the main direct. The 16 inch pipe from the clear water division connects, about 500 feet from the reservoir, with a 12 inch, and an 8 inch pipe, the 8 inch supplying the residence part of the city, and the 12 inch running directly to the thickly built up business portion, branching into two 10 inch and one 4 inch at the center of distribution. This center is 146 feet below the reservoir water line, and, making a fair allowance for all contingencies, there should be delivered, at least, 2,800,000 gallons of water per 24 hours. There is no point on the city pipe line at which the reservoir will not furnish an effective fire pressure, without help from the pumps."

The population of Knoxville is about 25,000, and the pumping and reservoir capacity, and distribution system as well, should supply each inhabitant with more than 100 gallons daily. The works were thoroughly tested when finished, and the city has twice the pumping capacity it contracted for; so we must confess that we see no just cause for complaint, unless, it should be inconvenient for the city to foot its bills at present, and this is the easiest way out of the dilemma.

NEWS OF THE WEEK.

Contracting.

New Court House.—Locke County will build a new $25,000 Court House.

Following bids were received at the Office of the Department of Public Works, No. 31 Chambers St. New York, on February 12th.

For furnishing (1) 1825 tons Cast-iron Water Pipe, (2) 75 tons Branch pipe and special castings.

Fox & Drummond, (1) $25.17, (2) $47.50 per ton; total, $49,475.75.

Camden Iron Works, (1) $24.80, (2) $47.85 per ton; total, $48,648.75.

Warren Foundry & Machine Co., (1) $24.90, (2) $47 per ton; total, $48,967,50.

Gloucester Iron Works, (1) $25.49, (2) $43.09 per ton; total, $49,475.

Contract awarded Feb. 13th to Camden Iron Works, provided sureties are approved by Comptrolier.

Raising the Steamer St. John.—The Steamer St. John, lately burned snd sunk at her wharf in the City of New York, was the largest river steamer in the world. She was 417 feet long, 55 feet beam and 96 feet wide over the wheel-houses. The original cost was $650,000 and the fire insurance was $200,000. On Jan. 29, 1885, Captain E. R. Lowe, the widely known submarine engineer, wrecker and diver, obtained the contract for raising the hull; he at once put his divers to work, and personally superintending their work under water, first stopped over two hundred holes in the steamer; on Feb. 11th he started his steam wrecking pumps at 11 A.M., and at noon of the same day the St. John was again afloat, and at 12.45 P.M. she was ready to be towed to the yard for re-building. The wrecking pumps used had a capacity of 32,000 gallons per minute. The signal success of Captain Lowe in this very considerable undertaking adds to his already well earned laurels as a successful submarine engineer.

Following Bids were opened Feb. 16th at Rock Island, Ill., by Major A. Mackenzie, Corps of Engineers, U. S. A, for construction of Dredge Hull. Point of delivery is mentioned below with each bid.

Alfred Cutting, Keokuk, Ia., $3250; Metropolis, Ill., $3050, *successful bid.*

Diamond Jo. Line of Steamers, Keokuk, Ia., $3500.

J. Bachelder, Keokuk, Ia., $3795.

Kahlke & Bro., Keokuk, Ia., $4490.

H. S. Brown, Quincy, Ill., $4500.

Alex. D. Fleck, Grafton, Ill., $4548.

Vansant & Edwards, St. Claire, Ia., $4740; Keokuk, Ia., $4815.

Edmonds J. Howard, Jeffersonville, Ind., $4800.

Jacob Eckhardt & Son, Davenport, Ia., $5950.

Railroad Bridges and Canals.

New Bridge.—Some of the citizens of the town of Wells, Me., are anxious to build a bridge across tide waters of Ogunquit river.

Canada and Atlantic.—The new Canada and Atlantic Road was opened last Monday for through business from Rouse's Point to Ottawa.

The Wisconsin Legislature has passed the bill authorizing the Chicago, Freeport & St. Paul Railroad Company to bridge the Wisconsin, Kickapoo, Chippewa, Black and Eau Galle Rivers and Lake St. Croix.

Bridge Blown Away.—The bridge across the Mad River in Thornton, near Waterville, Me., town line, was blown into the river on the 16th, by the terrible wind. This is the second time within a few years that the bridge at this place has been blown down.

The Mobile & West Alabama R. R. bill passed the Alabama Senate, 19 to 7, the convict feature left in. This insures the building of this great railroad by Milner, from the Mobile Gulf through the splendid coal fields of Walker County to Sheffield and the Tennessee river.

The Southern Cable Railroad Construction Company, of Cincinnati; capital stock, $300,000 is incorporated.

The Anniston and Northern railroad, to extend from Anniston, Ala., to Attala, there connecting with the Queen and Crescent line, is now an assured enterprise. The company have been wise enough to buy their steel rails on the present market, the price being the lowest ever reached in this country, namely $26 per ton.

Bridge Building.—The Athens Shops of the Union Bridge Co. have under way a 2,453 foot bridge, to span the Ohio at New Albany, Ind., with two cantilever spans at 483 feet each, also a drawbridge 360 feet long for the St. Louis, Iron Mountain & Southern over the Arkansas.

Dominion Parliament.—Bills have been introduced to incorporate the Fredericton and St Mary's railway Bridge Company.—Mr. Temple.

Respecting the Sault Ste. Marie Bridge Company.—Mr. Dawson.

New Bridge.—The steel superstructure and abutments for the Central Iowa bridge across the Mississippi River at Keithsburg are to cost $290,000 payable in cash or 6 per cent bridge bonds at $5, guaranteed by the Central Iowa Railroad Company, and secured by rental and sinking fund. There has already been expended upon the approaches to the bridge $80,000. The Phœnixville Bridge Co. are the contractors. Messrs. Wm. Sooy Smith & Son are the engineers.

The Clearfield and Jefferson Railway Company is chartered. The line will run from the Bells Gap Railroad terminus, in Clearfield County, Pa., to Punxsutawney, Jefferson County, a distance of thirty-two miles. The capital is $1,000,000. The directors are all Philadelphians, as follows: Charles F. Berwind, Aaron Fries, John Reilly, Samuel G. Lewis, F. R. Lewis, J. H Converse, Allison White.

The Paintersville and Port Perry Railroad Company is chartered. It will run from Port Perry, Alleghany County, Pa., to the main line of the South Pennsylvania Railroad at Stair's Mill, Westmoreland County, a distance of forty miles. The capital stock is $2,000,000. Lyman D. Gilbert, of Harrisburg, is president, and the directors are all Harrisburgers. Among the heavy stock-holders are William T. Sanger and F. J. Groetvent, both connected with the South Pennsylvania Road, and it is asserted that the new road is designed to tap the coke producing regions in the interest of the Vanderbuilt system.

A New Tunnel.—The Baltimore and Ohio Road will commence in a few weeks work upon the excavation of a tunnel through the hill at Thomas Station, twelve miles east of Washington, Pa., on the Wheeling and Pttsburg Division. This tunnel is intended to reduce the grade, which is now 125 feet to the mile, to 66 feet. The new tunnel will be 1,000 feet in length and will be completed this year, and, when done, will cut off quite a distance. It will run under the hill some distance to the north of the Thomas Station instead of to the south as it is at present.

Van Buren Ark. R. R. Bridge.—This bridge is the Arkansas River crossing of the St. Louis & San Francisco R. R. Wm. Sooy Smith & Son have just taken the contract for the building and sinking of five pneumatic caisson piers, from the Union Bridge Co., the contractors for the entire structure. Work will be commenced at once, and it is expected that the pier work will be finished in a few months. The firm of Wm. Sooy Smith & Son have completely finished their work upon the piers of the Havre de Grace Bridge of the Balt. & Ohio R. R.

Florida R. R.—Work on the proposed railroad from St. Andrew's Bay, in Florida, to Chipley, is to be commenced forthwith, and the incorporators believe that the road will be in running order by June next. The company has secured a grant of 257,000 acres of pine land along the proposed route, and has a capital of $1,000,000, with Judge Aldrich as president. It is proposed to settle the territory of this road with foreigners, and an immigration agent will be sent to Ireland and other parts of Europe. St. Andrew's Bay is on the Gulf coast, about midway of the western horn of Florida. The country is unsettled, and there is said to be a chance for development.

Arkansas River Bridge.—The Iron Mountain Railroad, has concluded to build a new bridge across the Arkansas River at Little Rock. The contract has been awarded to the Union Bridge Company of New York, and the new structure will cost several hundred thousand dollars. Work is to commence immediately, and the draw span is to swing not later than June 1. The new bridge is to be much heavier than the present structure and made so as to stand the weight of the consolidated engines. There will be six spans in addition to the northern approach. The accomodations for vehicles and foot passengers are to be of a high order, and the bridge and approaches are to be electric-lighted.

The Canadian Pacific.—Jas. Muir, of Muir Bros., talks as follows concerning the Canadian Pacific in the St. Paul *Globe:*

"The track of the Canadian Pacific is laid to the mouth of the Beaver River, at the foot of the Selkirk Range of the Rocky Mountains. Seventeen miles west of the first crossing of the Columbia River, grading is all under way, this being the distance between Beaver and the summit of the Selkirk Mountains. Heavy work is under way from the summit to the second crossing of the Columbia, which is all under contract. This winter the contractors have been busily engaged transporting construction supplies from Beaver, where they were delivered by the railroad company, by horses, to the scene of operation. The general construction is light and goes on rapidly as the grades are easy, and if everything continues as favorably as it has been of late the whole work will be completed by November 1, 1885. The Kicking Horse pass, which is now finished, was the greatest and most difficult piece of work on the line and required the most skillful engineers. My brother and myself had a contract of two tunnels and three miles to construct on this pass, which we finished last October, and we now have a contract to build two tunnels on the Selkirk range, and some heavy outside work. The two all completed were 335 and 330 feet long respectively, and one of those we have now contracted to build will be 500 feet long; the other has not been determined on yet by the engineers. The grading between Port Arthur and Montreal will be completed shortly, and about November 1st trains will run between Montreal and Victoria, B. C. On the west end of the line the distance yet to construct is 270 miles."

The Northern Pacific Junction railway, which will run from Gravenhurst, the present terminus of the Northern railway, to La Vasa, near Callendar, on the Canadian Pacific railway, besides tapping the latter railway for this province, will open up and make another large section of country commercially subject to Toronto. Messrs. Hendrie, Symmes & Co., the contractors for the construction of the line, have agreed to complete the work before the first of May of next year, but at the present rate of progress the work will be completed a considerable time before that date. The entire line is in the hands of sub-contractors, and 4,000 men and 1,000 teams are now and have been at work during the winter.

Mr. A. C. Bailly, the engineer in charge of the work says the country through which the line runs is very rough, in that respect the worst he has ever seen. It is very much like those parts of the counties of Hastings, Addington and Frontenac through which the Ontario division of the Canadian Pacific railway runs. The work is granite. The whole line is 111¼ miles in length.

The engineers located the line many times before they found a satisfactory route, and then what was thought to be the final location was changed to a route more to the westward. Besides an easier line, one of the most important advantages thus gained was the construction of fewer bridges across Muskoka lake. But although there is much rock, there is a great deal of good land in the valleys all along the line.

At Huntsville a few Americans are about to start a cheese factory. This place is beautifully situated on a fine river, over which a bridge is being built. The stream is 247 feet wide. The bridge will be 40 feet above the water. There will be one span of 150 feet and two of 80 feet. The whole country is full of deer, which can frequently be seen from the roads. The sub-contractors are mostly men who have had similar work on the Ontario and Quebec railway, and are therefore well acquainted with their work. A great many of the navvies are Italians. Although not as strong as Canadians they are steady and do good work. They live almost exclusively on bread. Every month regularly they send their earnings home to Italy, a New York banker of their own nationality acting as their agent. They do this because, like the Chinese, they intend returning to their own sunny clime as soon as they become rich enough to purchase a few acres of land upon which to live there. The Canadian Pacific Railway Company have already given orders for the placing of two Pullman sleepers on the line to connect with Toronto as soon as the work is completed.

St. Paul Projects.—The work laid out for next yea by the Minnesota & Northwestern Railroad Company and the West St. Paul Union Railway & Transfer Company, including the construction of the bridge across the Mississippi by the first-named corporation, will involve an expenditure of probably $650,000. It is now intended to build one general passenger station in West St. Paul, with three others for local travel to this side of the river, the buildings to be after the ornamental suburban stations of the Illinois Central near Chicago. The Minnesota yards and freight business will also be in West St. Paul. The bridge across the river, upon which a large force of men have been at work all winter driving piles and sinking piers through the ice, will cost $250,000. In length it will be 1,400 feet. It is to be constructed of iron and steel, and will consist of four fixed spans of 225 feet each and one draw span a little over 400 feet long. This draw will be the largest and heaviest in the United States. It will be operated by steam power. The piers are expected to be done by the middle of March. The most extensive piece of work contemplated, however, is the West Side levee. The West St. Paul Transfer Company has just been incorporated with a capital of 500,000, and in conjunction with the railway company propose to build two and one-half miles of levee twelve feet above the natural level of the ground and three feet above the river's high water mark. The material used will be earth, brought over the railroad from the back country, and the levee will be faced with stone ripraps for its entire length. It is estimated that for the work about 1,250,000 cubic yards of earth and 50,000 cubic yards of stone will be necessary. While the work of constructing the levee is going on the $15,000 appropriated by the Goverment for the improvement of the river will be expended. Maj. Mackenzie, who has charge of the river work, having made preparations for working on the river channel during the spring.

Important Railroad Statistics.—Mr. James C. Clarke, President of the Illinois Central Railroad, has submitted to the Hon. John A. Logan, United States Senator from Illinois, a statement showing the miles of railroad in operation in thirteen selected States in 1884, with area, population, and wealth of those States in 1880 and area, population, and wealth of each per mile of railroad. The statement is as follows:

States.	In operation in 1884.		Area of Land in States.			Population in 1880.			Wealth in 1880.			
	Miles of Railroad.	Rank as to miles.	Square miles.	Rank as to area.	Square miles to mile of railroad.	Number of People.	Rank as to Population.	People to miles of railroad.	Per United States census.	Rank as to wealth	Wealth per capita.	Wealth per mile of railroad.
Illinois	9,141	1	56,000	20	6 1-10	3,078,000	4	336	$3,092,000,000	4	1,005	338,000
Iowa	7,481	2	55,475	21	7 4-10	1,634,000	10	217	1,415,000,000	10	871	189,000
Pennsylvania	7,468	3	44,985	29	6	4,272,000	2	572	5,393,000,000	2	1,259	722,000
New York	7,369	4	47,620	26	6 5-10	5,081,000	1	689	7,619,000,000	1	1,499	1,034,000
Ohio	7,317	5	40,760	32	5 5-10	3,197,000	3	436	3,301,000,000	3	1,032	451,000
Texas	6,127	6	292,290	1	42 9-10	1,590,000	11	259	725,000,000	16	455	118,000
Indiana	5,570	7	35,910	34	6 4-10	1,978,000	6	355	1,499,000,000	7	758	270,00
Michigan	5,241	8	57,430	19	10 9-10	1,629,000	9	311	1,370,000,000	11	837	261,000
Missouri	4,754	9	68,735	15	14 4-10	2,167,000	5	455	1,530,000,000	6	706	322,000
Tennessee	2,112	21	41,750	30	19 8-10	1,542,000	12	730	466,000,000	18	432	315,000
Kentucky	1,852	25	40,000	33	21 5-10	1,649,000	8	890	880,000,000	13	534	475,000
Mississippi	1,616	28	46,340	27	28-6 10	1,130,000	18	705	324,000,000	28	286	200,000
Louisiana	1,204	29	45,220	28	37 7-10	939,000	22	781	422,000,000	24	449	350,000

Iron and steel bridge over the Big Miami River on the line of the C. I. St. L. & C. R. R., and trains commenced running over it on the 17th. The bridge is 532 feet long and cost $26,000; it rests on the old stone abutments, which were raised some two feet, and the grade of the road has been raised to conform to it.

A tunnel and railway: in length and engineering difficulties greater than the St. Gothard, are projected through the Luckmanier Alps, which will be of advantage chiefly to Eastern Germany, Switzerland, Bavaria and Italy. The estimated cost is about $20,000,000.

The Central Railroad Company Savannah, Ga. are making arrangements for the erection of three truck warehouses on the wharf, for the export of cotton, on the latest improved plan, and will shortly commence the construction of an iron bridge over the canal, preparatory to laying a railroad along the river front

The Massillon Bridge Co., have completed the new

New Smelting Works and R. R.—E. A. C. Pew, who is at present in Ottawa Canada, and Mr. Eccles, of New York, have organized a company to erect smelting works at Ironside and to construct a narrow gauge railway from Gatineau Point Canada, to Whitefoot Lake, a distance of 40 miles. Application for a charter will be made at the present session of Parliament. The capital of the company will be $500,000.

English Railroad.—An exchange says: "About 10 per cent of the total cost of an English railroad is expended in getting permission from Parliament to build it. During the last eleven years thirteen of the principal lines in the United Kingdom have spent $11,250,000 for leave to extend their lines."

A Bridge Across The St. Croix River.—WASHINGTON, Feb. 18.—A bill authorizing the construction of a bridge across the St. Croix river at Stillwater, Minn., passed the house and goes to the president for his signature. This will permit the completion of the Minneapolis and Sault Ste. Marie road, which Minneapolis people believe is going to carry all their wheat to Boston and Portland, as it is by way of the Canada Southern road, some 300 miles nearer the seaboard than by way of Chicago.

Proposed East River Tunnel.—Articles of incorporation of the East River Tunnel Railroad Company were filed at Albany on the 21st, with a capital stock of $2,000,000. The company proposes to build a tunnel between Ravenswood, L. I., and a point between Thirty-fourth and Eighty-sixth streets, this city. The entire line of the tunnel will be through solid trap rock. As the tunnel will pass under Blackwell's Island two shafts for light and air will be constructed,—one on each side of the island. The total length of the tunnel will be 3,510 feet, the distance under the river being 2,110 feet, and each approach 700 feet. The estimated cost is $1,500,000, about one-fifth of the estimated cost of the Blackwell's Island Bridge. In addition it is said that as a tunnel would offer no obstruction to navigation and cost much less for repairs and maintenance, it has many advantages over a bridge. The tunnel is intended to offer facilities for every class of travel, giving direct communication between all parts of Long Island and New York. Among the incorporators are Colonel Robert Townsend, R. Maclay Bull, John D. Lawrence, ex-Senator John Birdsall, Israel J. Merritt' William H. Bellamy, Colonel James H. Platt, David B. Sickles, L. Bradford Prince, E. Holland Nicholl, E. Platt Stratton A. G. Montgomery, Jr., and William W. Lawrence.

Ohio Legislature.—Mr. Young of Franklin, has introduced a bill authorizing the Commissioners of Franklin County to build a bridge over the Scioto at the Clickinger road.

President pro tem. White laid before the Senate a communication from the City Council of Columbus asking for the passage of a bill to allow them to borrow $50,000 to build a bridge over railroads in the North End.

THE BARBER ASPHALT PAVING COMPANY.

Irrespective of any advantages to be derived from the sheet asphalt pavement, in the luxury and comfort afforded those who ride, to say nothing of the facilities secured for light vehicles or heavy and loaded wagons, and the sanitary aspect of the case, it is essentially needed in a city like New Orleans, whose streets become miry and boggy after a rainfall. The value of property too becomes materially enhanced by its adoption, and the beauty and attractiveness of streets, either as thoroughfares or popular resorts, greatly augmented.

The Trinidad Asphalt Pavement has two especially remarkable qualities (not to mention many others.)

1. Durability of its foundation. It will last forever, yet is easily cut through and replaced.

2. Malleability of the wearing surface. Under traffic or blows, as of a heavy hammer, it compresses, but does not disintegrate. Being homogeneous, any portion if separate will unite under traffic.

The surface compresses but wears imperceptibly. It is impervious, smooth and noiseless, without being slippery. Nothing in its composition to create dust and nothing to which dust will adhere and create mud.

No less distinguished authorities than Generals Wright and Meigs, Major Twining and Lieutenant Greene of the United States Army commend this pavement above all others, especially for such celebrated streets as Pennsylvania avenue in Washington and like well-known avenues. A single extract from the report of Q. A. Gillmore, Lieutenant-Colonel of Engineers and Brevet Brigadier-General, adds great strength to the general testimony He says, writing to Colonel A. L. Barber:

"I was a member of a Commission which selected your pavement for covering Pennsylvania avenue, Washington, D. C., in 1876, as the best known pavement for the purpose, and nothing has occurred since thes to change my opinion that the selection was a wise one. I would make the same selection to-day if the question was before me."

Over 1,075,000 yards of the Trinidad Sheet Asphalt Pavement have been laid with excellent results in cities subjected to extreme climatic influences, and the success of the work hinges upon the fact that the pavement is laid upon the best foundations known to the engineers of the world—the best hydraulic concrete. the absence of coal-tar in its composition, but all the asphalt, that eleven years' experience teaches the pavement can carry to advantage.

During the last twelve months the Barber Asphalt Paving Company has constructed in Washington, D. C.; Omaha, Neb.; Buffalo, N. Y.; Erie and Youngstown, Pa., over 140,000 square yards of sheet asphalt, and have contracts made to pave in St. Louis, Washington

City and Omaha, Neb., 175,000 square yards in addition, and a contract in New Orleans amounting to about 150,000 square yards.

The total awards for sheet asphalt in twelve months, 470,000 square yards.

There has been previously laid in the United States over 500,000 square yards.

What paving company can present a like evidence of public favor and confidence.—*N. Y. Graphic*, 24th inst.

THE latest electric light project is designed to illumine the Atlantic Ocean from the banks of Newfoundland to the shores of Ireland. Ten vessels stationed 200 miles apart, each riding at a "mushroom" anchor, which permits the vessel to swing round with the tide, are to display the lights. These vessels are also to be connected together and to the shore by an electric cable, and thus be enabled to send messages to any part of the world.

THE Assistant General Counsel of the Lake Shore Road was rejoiced recently to receive from some anonymous source a clipping from a Detroit paper, on which appears an alleged effusion from the Sweet Singer of Michigan. She has been silent too, too long, and it shows her versatility that with her facile pen she should pay a tribute to the counsel for the company. It was written in sentimental blue ink and rhymes from north to south and from east to west. Here is one stanza of her tender tribute: "Mrs. Mary M. Tuttle of Ann Arbor, the officers of the Lake Shore do abhor. In '83 to Cleveland she wished to go, and she entered the car down at Toledo. As she had no tickets she offered money, but the conductor did not think it funny. Down at Sandusky he put her off the train. She sued the company that she might have gain, and a very small amount she did obtain, $3.50 gave her pain."—*Cleveland Herald*, 20th.

A MOUNTAIN THAT MOVES.—Over in Churchill county, Nevada, there is a great curiosity, mention of which we do not remember to have ever seen in the papers. This curiosity is nothing more nor less than a traveling mountain of sand. The winds have gathered together a great heap of sand and keep it constantly moving like an immense glacier. It crawls steadily along over valleys and through canyons, never ceasing, the sands making a low musical sound as they rub against each other, much as they do around the Sphinx every morning at sunrise, which gave rise to the legend that the stony statue was greeting the morning sun with a song. But the moving mountain of Churchill contains still another peculiarity. While its sides are symmetrically formed and lay in folds like solidified waves there is no cone at the top. Instead of it going to a peak there is a hole there made by counter winds, and whoever is rash enough to scale the ridge and pass into that hole pays for his rashness with his life, for the fickle sands yield beneath his feet, and the more he struggles to get back the faster he sinks, until he is smothered to death The Indians tell of several of their tribe having been thus swallowed up, and no trace has ever been found of them since.—*Reese River Reveille.*

Index to Periodical Literature.

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Societies. *Am. Soc. of Civil Engineers.* Proceedings of Annual Meetings. *Engineering News*, January 24, 1885, pp. 56 and 57.

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Steam Hammer. *Who invented the Steam Hammers?* A statement of the rival claims of Nasmyth and Bourdon. *Engineering News*, January 24, 1885, pp. 59-60.

Track. *Track.* A valuable series of articles describing in detail and with numerous illustrations, the best practice in track-laying. By W. B. Parsons, *Engineering News*, began Oct., 4, 1884, and still running. Loose bolts and their remedies, in Jan., 31st; and various forms of fastenings, in Feb. 7, 1885.

Tunnel, Salina. *The Salina Tunnel.* Describing the construction of a curved tunnel, the methods of alignment, etc., with drawings showing in detail the plan, timbering, centering, arching, masonry work, etc. By Samuel Rea. *Proc. Engineers Club of Philadelphia*, Mar., 1884, p. 40.

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Water Pipe, Cast Iron. *Highest and lowest prices of, from 1872 to 1884.* Shown by diagram. Chas. G. Darrach, *Engineering News*, Jan. 31, 1885, p. 67.

Water Softening. *Softening of Water.* A description of the various processes and inventions employed in the past and present. By Baldwin Latham M. Inst. C. E. etc., *Engineering News*, Jan. 31st and Feb. 7th, 1885, pp. 65, 66 and 81, 82.

Water Supply. New York. *Adirondack Water Supply for New York and the Hudson Valley Cities.* Brief abstract from Mr. Fanning's report on the proposed plan. *Engineering News*, Jan. 24th, 1885, p. 58.

Water Supply, New York. *Contract prices of New York Aqueduct.* Tabulated statement in detail of engineers' estimate of quantities and the prices bid on such class of work. *Sanitary Engineer*, Jan. 1st, 1885.

Water Supply, Statistics. *History and Statistics of American Water Works.* A series of articles describing the water-works of nearly all the important cities and towns in America. For each city or town is given the source of the supply, the kind of water-works, daily consumption, cost, etc., By J. Jas. R. Croes, *Engineering News.* Begun March 5th, 1881, and still running.

Market Report of Engineering Materials.

New York, February 26, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.		
Angles	2.3c. @	2.6c.
Tee	2.8c. @	3c.
Beams and channels	3.0c. @	3.5c.
Tank	2.2c. @	2.3c.
Shell	2¾c.	
Steel plates, Tank	3c. @	3½c.
WROUGHT-IRON PIPE.. PITTSBURGH.		
Butt welded, black ..... Discount	47½	
" " galvanized ..... "	40	
Lap welded black ..... "	65 @	67½
" Galvanized ..... "	47½ @	50
Boiler tubes ..... "	60	
RAILS.		
Steel (large lots at mill)	$27 @	28
Old rails	16.50 @	17.00
Old rails, steel	15.50 @	16.50
R. R. spikes		3c
R. R. splice-plates	1.65c. @	1.75c.
R. R. Track Bolts	2¼ @	2½
Barb-wire fencing, galvanized		9c
" " painted		4c.
Corrugated iron		
Nails		
Iron	2.25	
Steel	2.35	

METALS.

COPPER.		
Lake Superior	11¼ @	.11⅝
Other Brands	10⅜ @	11
LEAD.		
Com. Domestic	3.60 @	3.70
Lead Pipe	.06¾	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.06¾	
ZINC.		
Sheet	.05	5⅛

BRICK.

(Cargoes afloat)		
Haverstraw 1st ..... per M.	$6.00 @	6.25
" 2nd ..... "	5.62 @	5.87
Fishkill	4.75 @	5.50
Up-River	5.25 @	6.00
Jerseys		
Long Island		
" pale		
FRONTS.		
Croton red	14.00 @	
" dark	14.00 @	
" brown	12.00 @	
Philadelphia pressed	22.50 @	23.00
Trenton "	22.50 @	23.00
Baltimore "	37.00 @	41.00
Buff "	33.00 @	35.00
Enameled English	65.00 @	130.00
" American	85.00 @	120.00
Fire brick	25.00 @	40.00

CEMENT.

PORTLAND.		
Robins & Co., Extra English 425 lbs. per bbl.	2.75 @	2.90
K. B. & S. English 400 lbs.	2.85 @	3.00
Burham " "	2.70 @	2.85
Rochester Castle " "	2.50 @	2.60
J. B. White & Bro. " "	2.50 @	2.60
Other brands, " "	2.40 @	2.50
Keene's fine " "	9.50 @	9.75
" course " "	5.25 @	5.50
Roman	2.75 @	3.50
Dyckerhoff, German 400 lbs.	2.60 @	2.65
Star, " "	2.60 @	2.65
Alsen, " "	2.55 @	2.60
Hanover " "	2.40 @	2.50
Other brands, " "	2.35 @	2.40
Saylor's American	2.15 @	2.50
Rosendale cements	0.90 @	1.00

LIME.

Rockland common per bbl	1.00	
" finishing	1.20	
Glensfalls, common	.85	
" finishing	1.05 @	1.10
Kingston, ground	0.95	

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.90 @	95
" " " No. 2 "	0.75 @	0.80
" " light drab "	0.80 @	0.95
Berlin " in rough "	0.75 @	1.00
Berea " "	0.75 @	1.00
Brownstone, Portland, Ct. "	1.00 @	1.30
" Belleville, N. J. "	0.75 @	1.25
Granite, rough	0.60 @	1.25
Common building stone per load	2.00 @	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40 @	3.00

SLATE.

Purple roofing per square	6.00 @	7.00
Green "	6.00 @	7.00
Red "	15.00	
Black Penna. (at New York) "	4.50 @	5.00

LUMBER.

PINE, Common box per M.	18.00 @	20.00
Good "	55.00 @	60.00
Tally plank, 1¼ in each.	.44 @	.50
Tally boards, dressed "	.28 @	.30
SPRUCE, Boards dressed "	.25 @	.28
Plank, 1¼ in "	.28 @	.30
" 2 in. "	.38 @	.40
" 2 in. dressed "	.43 @	.45
Timber per M.	20.00 @	22.00
HEMLOCK, Boards each.	.18 @	.20
Joist, 2½ × 4 to 4 × 6 in	.17 @	.44
OAK per M.	55.00 @	65.00
CYPRESS 1, 1¼, 2 and 2½ in "	35.00 @	40.00
YELLOW PINE, Girders "	26.00 @	35.00
Dressed flooring "	30.00 @	40.00
SHINGLES, Extra shaved pine, 18in. "		
" " sawed 18 in. "	4.50 @	5.00
LATH, Cargo rate "	2.50 @	2.60

PAINT.

Lead, white, American dry per lb.	.04¾ @	.05
" " in oil pure "	.05½ @	.05¾
English, B. B. in oil "	.08¼ @	.08¾
Red, American "	.05½ @	.05⅝
Litharge "	.05 @	.05¼
Venetian red, American "	.01 @	.01¼
Indian red "	.05 @	.10
Vermillion, American lead "	.11 @	.11½
Paris green "	.15 @	.19
Umber, Amer. raw and powdered per lb.	.01¼ @	.01½
Drop black, Amer. "	.08 @	.12
" " "	.09 @	.11½
Chrome green	.05 @	.15
Oxide zinc, American	.03½ @	.04
" French	.06¼ @	.06½

PROVIDENCE, R. I., has adopted the Goddare plan for improved terminal facilities by bringing the railroad through the city on elevated tracks, and giving up of the Cove Park for railroad purposes. A magnificent new union depot is to be built. The cost to the railroad will be about $3,000,000 and to the city about $1,000,000. It is expected that these improvements will make Providence a great railway centre and a rival of Boston.